

# THE SUBGENERIC DIVISION OF THE GENUS *BOMBUS* LATREILLE (HYMENOPTERA : APIDAE)

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## CONTENTS

	<i>Page</i>
INTRODUCTION . . . . .	211
ALPHABETICAL LIST OF NAMES AVAILABLE FOR THE SUBGENERA OF <i>Bombus</i>	213
NOTE ON GROUP-NAMES . . . . .	218
CHARACTERS OF THE SUBGENERA OF <i>Bombus</i> . . . . .	219
DESCRIPTIONS OF THE SUBGENERA . . . . .	221
KEYS TO SUBGENERA OF <i>Bombus</i> LATREILLE . . . . .	260
Males . . . . .	260
Females . . . . .	265
REFERENCES . . . . .	273

## SYNOPSIS

The described subgenera of *Bombus* Latreille are revised and listed and their characters discussed ; thirty-five subgenera are recognized as valid. Full synonymy is given and keys to males and females only are provided.

THE current system of named subgenera for the large genus *Bombus* Latreille was first started by Vogt (1911) and Skorikov (1914, 1922). Originally, the subgenera were merely groups whose males possessed more or less closely similar genitalia and the names proposed for them were derived from the specific name of one of the included species. The system has gradually been elaborated and more names have been added; some of the old ones have tended to drop out because earlier names of von Dalla Torre (1880) were found to be available. Very few attempts have been made to provide a key to the sub-genera, many of which have never been described in detail. The females have been even more neglected than the males and though all sorts of characters have been indicated in the very scattered literature as helpful in recognizing the females of certain groups, no systematic account of the subgeneric classification of this sex is available. Some features of the European species were indicated by Krüger (1917, 1920) and Pittioni (1939a) even gave a key of a somewhat artificial type to the East European subgenera. Neither of these authors, however, referred to the important characters which can be found in the sting. Some of these had been noted by Richards (1927) and the North American species have recently been fully illustrated by Hazeltine & Chandler (1964). There is clearly a need for proper descriptions of the subgenera and for a key to them which includes all of them and not merely those of a small region.

Meanwhile, Milliron (1961) produced a new classification of *Bombus* which he divided into three genera, two each with two subgenera. He recognized no other

subgenera though he mentions a number of "species groups". I find Milliron's system unsatisfactory partly for fundamental reasons, partly because there are a number of errors in detail; some of these may be misprints but others are incomprehensible.

The key to the genera and subgenera (pp. 54-55) depends largely on venational characters, which prove to be quite unworkable in a number of species on which they have been tested. Moreover, two of his genera, *Pyrobombus* von Dalla Torre and *Megabombus* von Dalla Torre, each fall in two halves of his key, so that their reintegration is essentially arbitrary. A number of exceptions have to be made for particular species suggesting that perhaps his genera would really be better split. Other points, more of detail, in Milliron's system which are very difficult to defend include, (1) putting *Obertobombus* Reinig in *Pyrobombus* sgen. *Pyrobombus* von Dalla Torre while *Sibiricobombus* Vogt (of which it is a synonym) is put in *Pyrobombus* sgen. *Cullumanobombus* Vogt, (2) putting *Thoracobombus* von Dalla Torre in *Pyrobombus* and not near its close allies in *Megabombus* von Dalla Torre, (3) separating *B. dentatus* Handlirsch and its subspecies *orichalceus* Friese from *Alpigenobombus* Skorikov (to which they clearly belong) and placing them in *Bombias* Robertson, with which they have little in common and further in putting with them *B. haueri* Handlirsch, which is really a member of *Crotchiibombus* Franklin which he places in *Pyrobombus* von Dalla Torre, (4) placing *Kallobombus* von Dalla Torre, *Alpinobombus* Skorikov and *Orientalibombus* Richards in *Megabombus* von Dalla Torre all the other groups of which have spinose mid basitarsi in the female.

Medler (1962a, 1962b) has made a number of studies of the wings and mouthparts of humblebees, measuring in particular the length of the marginal cell, the length of the glossa and the ratio of the length of the first segment of the labial palp to the length of the prementum (= labial index). He suggests (1962a : 217) that the group of species allied to *B. pratorum* (Linnaeus) (subgenus *Pyrobombus* von Dalla Torre) is an unnatural one because of discrepancies in the value of these indices. While it has long been known that the very large subgenus *Pyrobombus* includes species with a considerable range of structure I cannot agree that the group is unnatural. The subgenera are really defined on a number of characters of both sexes though the male genitalia are often the simplest means of reaching a quick identification. Indices are often very valuable for distinguishing species but must be used with care as indicators of relationships. The palps and mouthparts are almost certainly liable to rapid adaptation and may well be imperfect indicators of phylogenetic relationships.

The classification of *Bombus* has never been very closely set out but most specialists in the taxonomy of the genus are reasonably satisfied with something approaching the schemes of Vogt & Skorikov. The scheme set out below is far from original and cannot be regarded as final. Although the author is responsible for any errors, he is very grateful for much help and advice from Drs J. F. Perkins, B. Tkalců and I. H. H. Yarrow.

Alphabetical list of names available for the subgenera of *Bombus*.

Numbers are attached to the valid groups or to groups later described, and show the order in which they are dealt with in the descriptions.

30. **ADVENTORIBOMBUS** Skorikov, 1922 : 150.

Proposed as subgenus of *Agrobombus* Vogt. Type-species *Agrabombus* [sic] *adventor* Skorikov, 1914 = *Bombus adventor* (Skorikov, 1914), by designation of Sandhouse, 1943 : 522. (p. 254).

*AGROBOMBUS* Vogt, 1911 : 52.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus agrorum* (Fabricius) = *Apis agrorum* Fabricius, 1787 nec Schrank, 1781 [= *Apis* [*Bombus*] *pascuorum* (Scopoli, 1736)], by designation of Sandhouse, 1943 : 523.

Synonym of *Thoracobombus* von Dalla Torre. **Syn. n.**

*AGRIBOMBUS* Skorikov, 1938 : 145. [Emend.]

1. **ALPIGENOBOMBUS** Skorikov, 1914 : 128.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus lefebvrei* Lepeletier, 1836. [= *B. mastrucatus* Gerstäcker, 1869], by original designation. (p. 221).

*ALPIGENIBOMBUS* Skorikov, 1938 : 122. [Emend.]

18. **ALPINOBOMBUS** Skorikov, 1914 : 122.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bremus alpinus* (Linnaeus) = *Bombus alpinus* (Linnaeus) = *Apis alpinus* Linnaeus, 1758, by designation of Frison, 1927 : 66. (p. 239).

*ALPINIBOMBUS* Skorikov, 1937 : 53. [Emend.]

*ANODONTOMBUS* Krüger, 1917 : 61, 65.

Proposed as a sectional name but according to Milliron, 1961 : 53 it is synonymous with *Pyrobombus* von Dalla Torre, 1880.

*ATROCINTOB.* [*OMBUS*] Skorikov, 1933b : 244, Table 1.

Not described and no type-species designated, but two species, *Bombus atrocinctus* Smith, 1872 and *Bombus terminalis* Smith, 1872, were included. This must be treated as a *nomen nudum*.

*BOMBELLUS*, *Zool. Record, Insecta*, 1931 : 248, *nomen nudum*.

Not in Wild, 1931, *Scott. Nat.* 190 : 118, as claimed.

9. **BOMBIAS** Robertson, 1903 : 176.

Proposed as a genus. Type-species *Bombias auricomus* Robertson, 1903 [= *B. nevadensis* Cresson, 1874 ssp.], by original designation (p. 230).

5. **BOMBUS** Latreille, 1802a : 385, 1802b : 437.

Proposed as a genus. Type-species *Apis terrestris* Linnaeus, 1758, monobasic. (p. 266).

*BOOPOBOMBUS* Frison, 1927 : 62.

Sectional name.

*BREMUS* Jurine, 1801 : 164.

Proposed as a genus. Type-species *Bremus terrestris* (Linnaeus) = *Bombus terrestris* (Linnaeus) = *Apis terrestris* Linnaeus, 1758 by designation of Morice & Durrant, 1915 : 428. Invalidated, Hemming, 1939.

*CALLOBOMBUS* von Dalla Torre, see *Kallobombus* von Dalla Torre.

*CHROMOBOMBUS* von Dalla Torre, 1880 : 40.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus muscorum* (Linnaeus) = *Apis muscorum* Linnaeus, 1758, by designation of Sandhouse, 1943 : 538. Synonym of *Thoracobombus* von Dalla Torre. **Syn. n.**

21. **COCCINEOBOMBUS** Skorikov, 1922 : 157.

Proposed as a subgenus of *Alpigenobombus* Skorikov. Type-species *Alpigenobombus coccineus* (Friese) = *Bombus coccineus* Friese, 1903 : 254 by designation of Sandhouse, 1943 : 539. (p. 243).

7. **CONFUSIBOMBUS** Ball, 1914 : 78.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus confusus* Schenck, 1859. Monobasic.

**CONFUSOBOMBUS** Skorikov, 1922 : 149 [apparently independently proposed as a subgenus of *Bombus*]. *Bombus confusus* Schenck, 1859 = *Confusobombus confusus* (Schenck) here designated as TYPE-SPECIES (p. 228). Synonym of *Confusibombus* Ball.

11. **CROTCHIBOMBUS** Franklin, 1954 : 51.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus crotchii* Cresson, 1878 by original designation. (p. 231).

13. **CULLUMANOBOMBUS** Vogt, 1911 : 57.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bremus cullumanus* (Kirby) = *Bombus cullumanus* (Kirby) = *Apis cullumana* Kirby, 1802, by designation of Frison, 1927 : 66. (p. 233).

**CULLUMANIBOMBUS** Skorikov, 1938 : 145-146. [Emend.]

24. **DIVERSOBOMBUS** Skorikov, 1914 : 406.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus diversus* Smith, 1869 by designation of Sandhouse, 1943 : 546. (p. 247).

28. **EVERSMANNIBOMBUS** Skorikov, 1938 : 145.

Proposed as subgenus of *Agribombus* = *Agrobombus* Vogt. Included only *A. (E.) evermanniellus* (Skorikov) = *Mucidobombus evermanniellus* Skorikov, 1922 = *B. evermanni* Friese, 1911 nec *B. modestus* Eversmann ssp. *evermanni* Skorikov, 1910, which is here designated as the TYPE-SPECIES by monotypy and by virtual tautonymy. (p. 252).

29. **EXILOBOMBUS** Skorikov, 1922 : 150.

Proposed as a subgenus of *Mucidobombus* Skorikov. Type-species *Mucidobombus exil* [misprinted *exiln. nov*] Skorikov, 1922 = new name for *Bombus nymphae* Skorikov, 1909 ♀ only, not ♂ ♀. Monobasic. (p. 253).

35. **FERVIDOBOMBUS** Skorikov, 1922 : 153.

Proposed as a genus. Type-species *Bremus fervidus* (Fabricius) = *Fervidobombus fervidus* (Fabricius) = *Bombus fervidus* (Fabricius) = *Apis fervida* Fabricius, 1798, by designation of Frison, 1927 : 69. (p. 259).

6. **FRATERNOBOMBUS** Skorikov, 1922 : 156.

Proposed as a subgenus of *Alpigenobombus* Skorikov. Type-species *Alpigenobombus fraternus* (Smith) = *Bremus fraternus* (Smith) = *Bombus fraternus* (Smith) = *Apathus fraternus* Smith, 1854 by designation of Frison, 1927 : 63. (p. 227).

22. **FUNEBRIBOMBUS** Skorikov, 1922 : 157.

Proposed as a subgenus of *Alpigenobombus* Skorikov. Type-species *Alpigenobombus funebris* (Smith) = *Bombus funebris* Smith, 1854. Monobasic. (p. 244).

*HORTOMBUS* Vogt, 1911 : 56.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus hortorum* (Linnaeus) = *Apis hortorum* Linnaeus, 1761 by designation of Sandhouse, 1943 : 559.

Synonym of *Megabombus* von Dalla Torre.

*HORTIBOMBUS* Skorikov, 1938 : 146. [Emend.]

*HYPNOROBOMBUS* Quilis Pérez, 1927 : 97.

*HYPNORUBOMBUS* Quilis Pérez, 1927 : 19. [Error.]

Proposed as a subgenus of *Bombus*. Type-species *Bombus hypnorum* (Linnaeus) = *Apis hypnorum* Linnaeus, 1758. Monobasic.

Synonym of *Pyrobombus* von Dalla Torre.

4. **KALLOBOMBUS** von Dalla Torre, 1880 : 40.

*CALLOBOMBUS* von Dalla Torre, 1896 : 503. Invalid [emendation].

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus soroensis* (Fabricius) = *Apis soroensis* Fabricius, 1777 by designation of Sandhouse, 1943 : 561. (p. 225).

*KOZLOVIBOMBUS* Skorikov, 1922 : 152.

Proposed as a genus. Type-species *Kozlovibombus kozlovi* (Skorikov) = *Bombus kozlovi* Skorikov, 1909 = *Bombus kohli* Vogt, 1909 nec Cockerell, 1906 by designation of Sandhouse, 1943 : 561.

Synonym of *Melanobombus* von Dalla Torre. **Syn. n.**

27. **LAESOBOMBUS** Skorikov, 1922 : 150.

Proposed as a subgenus of *Agrobombus* Vogt. Type-species *Agrobombus laesus* (Morawitz) = *Bombus laesus* Morawitz, 1875. Monobasic. (p. 251).

*LAESIBOMBUS* Skorikov, 1938 : 145. [Emend.]

*LAPIDARIOBOMBUS* Vogt, 1911 : 58.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus lapidarius* (Linnaeus) = *Apis lapidaria* Linnaeus, 1758 by designation of Sandhouse, 1943 : 562.

Synonym of *Melanobombus* von Dalla Torre.

*LAPIDARIIBOMBUS* Skorikov, 1938 : 145-146. [Emend.]

*LAPPONICOBOMBUS* Quilis Pérez, 1927 : 19, 22, 63.

*LAPONICOBOMBUS* Neave, 1940 : 143. [Error.]

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus lapponicus* (Fabricius) = *Apis lapponica* Fabricius, 1793 by designation of Milliron, 1961 : 58.

Synonym of *Pyrobombus* von Dalla Torre.

*LEUCOBOMBUS* von Dalla Torre, 1880 : 40.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus terrestris* (Linnaeus) = *Apis terrestris* Linnaeus, 1758 by designation of Sandhouse, 1943 : 564.

Synonym of *Bombus* Latreille s.s.

*MASTRUCATOBOMBUS* Krüger, 1917 : 66.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus mastrucatus* Gerstäcker, 1869 [= *Bombus lefebvrei* Lepeletier, 1836]. Monobasic.

Synonym of *Alpigenobombus* Skorikov.

23. **MEGABOMBUS** von Dalla Torre, 1880 : 40.

[*MEGALOBOMBUS* Schulz, 1906 : 267. Invalid emendation].

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus ligusticus* Spinola, 1805 = *Apis argillacea* Scopoli, 1763. Monobasic. (p. 246).

15. **MELANOBOMBUS** von Dalla Torre, 1880 : 40.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus lapidarius* (Linnaeus) = *Apis lapidaria* Linnaeus, 1758 by designation of Sandhouse, 1943 : 569. (p. 236).

8. **MENDACIBOMBUS** Skorikov, 1914 : 125.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus mendax* Gerstäcker, 1869 by designation of Sandhouse, 1943 : 572. (p. 229).

32. **MUCIDOBOMBUS** Skorikov, 1922 : 149.

Proposed as a genus. Type-species *Bombus mucidus* Gerstäcker, 1869 by designation of Sandhouse, 1943 : 574. (p. 256).

**NEVADENSIBOMBUS** Skorikov, 1922 : 149.

Proposed as a genus. Type-species *Bremus nevadensis* (Cresson) = *Bombus nevadensis* Cresson, 1874 by designation of Frison, 1927 : 64.

Synonym of *Bombias* Robertson, 1903.

2. **NOBILIBOMBUS** Skorikov, 1933a : 62.

Proposed as a genus but no type-species was designated. Listed by Sandhouse (1943 : 577) but without type-designation. Type-species cited as *Bombus nobilis* Skorikov, 1904 by Milliron, 1961 : 54 but there is no such species. TYPE-SPECIES of the subgenus is here fixed as *B. nobilis* Friese (1904) 1905 by virtual tautonymy. The nature of this species is unfortunately controversial (see p. 222) but I believe this arrangement to be the best at the moment.

**OBERTOBOMBUS** Reinig, 1930 : 107.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus oberti* Morawitz, 1883. Monobasic.

Synonym of *Sibiricobombus* Vogt. **Syn. n.** [but see Sandhouse, 1943 : 579].

**ODONTOBOMBUS** Krüger, 1917 : 61, 65.

Proposed as a sectional name but stated by Milliron, 1961 : 57 to be equivalent to *Megabombus* von Dalla Torre.

3. **ORIENTALIBOMBUS** Richards, 1929 : 378.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus orientalis* Smith, 1854 by original designation. (p. 224).

**POECILOBOMBUS** von Dalla Torre, 1882 : 23.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus sithensis* Nylander, 1848 by designation of Sandhouse, 1943 : 589. Synonym of *Pyrobombus* von Dalla Torre.

**POMOBOMBUS** Krüger, 1917 : 65.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus pomorum* (Panzer) = *Bremus pomorum* Panzer, 1804 by designation of Sandhouse, 1943 : 589.

Synonym of *Rhodobombus* von Dalla Torre.

**POMIBOMBUS** Skorikov, 1938 : 145-146. [Emend.]**PRATOBOMBUS** Vogt, 1911 : 49.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bremus pratorum* (Linnaeus) = *Bombus pratorum* (Linnaeus) = *Apis pratorum* Linnaeus, 1761 by designation of Frison, 1927 : 67.

Synonym of *Pyrobombus* von Dalla Torre.

**PRATIBOMBUS** Skorikov, 1937 : 59; 1938 : 146. [Emend.]

16. **PRESSIBOMBUS** Frison, 1935 : 342.

Proposed as a subgenus of *Bremus* Panzer. Type-species, monobasic and by original designation, *Bremus pressus* Frison, 1935 = *Bombus pressus* (Frison). (p. 237).

14. **PYROBOMBUS** von Dalla Torre, 1880 : 40.

*PYRRHOBOMBUS* von Dalla Torre, 1882 : 28. [Invalid emendation.]

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus hypnorum* (Linnaeus) = *Apis hypnorum* Linnaeus, 1758. Monobasic. (p. 234).

34. **RHODOBOMBUS** von Dalla Torre, 1880 : 40.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bremus pomorum* Panzer, 1804 = *Bombus pomorum* (Panzer) by designation of Sandhouse, 1943 : 596. (p. 258).

19. **ROBUSTOBOMBUS** Skorikov, 1922 : 157.

Proposed as a subgenus of *Alpigenobombus* Skorikov. Type-species *Alpigenobombus robustus* (Smith) = *Bombus robustus* Smith, 1854 by designation of Sandhouse, 1943 : 597. (p. 240).

20. **RUBICUNDOBOMBUS** Skorikov, 1922 : 154.

Proposed as a subgenus of *Fervidobombus* Skorikov. Type-species *Fervidobombus rubicundus* (Smith) = *Bombus rubicundus* Smith, 1854 by designation of Sandhouse, 1943 : 597. (p. 241).

17. **RUFIPEDIBOMBUS** Skorikov, 1922 : 156.

*RUFIPEDOBOMBUS* Milliron, 1961 : 54. [Error].

Proposed as a genus. Type-species *Rufipedibombus rufipes* (Lepelletier) = *Bombus rufipes* Lepelletier, 1836. Monobasic. (p. 238).

*RUFOCINCTOBOMBUS* Frison, 1927 : [78] pl. 17, fig. 9.

Type-species *Bremus rufocinctus* (Cresson) = *Bombus rufocinctus* Cresson, 1863, monobasic. Presumably an error since on p. 65 Frison uses the name *Cullumanobombus*.

Synonym of *Cullumanobombus* Vogt.

25. **SENEXIBOMBUS** Frison, 1930 : 3.

Proposed as a subgenus of *Bremus* Panzer. Type-species *Bremus senex* (Vollenhoven) = *Bombus senex* Vollenhoven, 1873 by original designation. (p. 248).

10. **SEPARATOBOMBUS** Frison, 1927 : 64.

Proposed as a subgenus of *Bremus* Panzer. Type-Species *Bremus separatus* (Cresson) = *Bombus separatus* Cresson, 1863 = *Apis griseocollis* Degeer, 1773 by original designation. (p. 231).

12. **SIBIRICOBOMBUS** Vogt, 1911 : 60.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus sibiricus* (Fabricius) = *Apis sibirica* Fabricius, 1781 by designation of Sandhouse, 1943 : 599. (p. 232).

*SIBIRICIBOMBUS* Skorikov, 1938 : 145-146. [Emend.]

*SOROENSIBOMBUS* Vogt, 1911 : 63.

*SOROENSIBOMBUS* Skorikov, 1923 : 151. [Error.]

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus soroensis* (Fabricius) = *Apis soroensis* Fabricius, 1777. Monobasic.

Synonym of *Kallobombus* von Dalla Torre.

33. **SUBTERRANEOBOMBUS** Vogt, 1911 : 62.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bremus subterraneus* (Linnaeus) = *Bombus subterraneus* (Linnaeus) = *Apis subterranea* Linnaeus, 1758 by designation of Frison, 1927 : 68. (p. 257).

*SUBTERRANEIBOMBUS* Skorikov, 1938 : 145-146. [Emend].

*SULCOBOMBUS* (Vogt) Krüger, 1917 : 65.

Proposed as a group name to include *Mendacibombus* and *Confusobombus*, but type-species designated by Sandhouse, 1943 : 502 as *Bombus confusus* Schenck, 1859.

Synonym of *Confusibombus* Ball.

*TANGUTICOBOMBUS* Pittioni, 1939b : 201.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus tanguticus* Morawitz, 1886. Monobasic and by original designation.

Synonym of *Melanobombus* von Dalla Torre. **Syn. n.**

*TERRESTRIBOMBUS* Vogt, 1911 : 55.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bremus terrestris* (Linnaeus) = *Bombus terrestris* (Linnaeus) = *Apis terrestris* Linnaeus, 1758 by designation of Frison, 1927 : 67.

Synonym of *Bombus* Latreille.

31. **THORACOBOMBUS** von Dalla Torre, 1880 : 40.

Proposed as a subgenus of *Bombus* Latreille. Type-species *Bombus sylvarum* (Linnaeus) = *Apis sylvarum* Linnaeus, 1761 by designation of Sandhouse, 1943 : 604. (p. 255).

26. **TRICORNIBOMBUS** Skorikov, 1922 : 1515.

Proposed as a subgenus of *Agrobombus* Vogt. Type-species *Agrobombus tricornis* (Radoszkowsky) = *Bombus tricornis* Radoszkowsky, 1888. Monobasic. (p. 249).

*UNCOBOMBUS* Krüger, 1919 : 65.

Proposed as a group name to include *Lapidariobombus*, *Pratobombus*, *Cullumanobombus* and *Mastrucatobombus*.

*VOLUCELLOBOMBUS* Skorikov, 1922 : 149.

Proposed as a genus. Type-species *Volucellobombus volucelloides* (Gribodo) = *Bombus volucelloides* Gribodo, 1891. Monobasic.

Synonym of *Robustobombus* Skorikov. **Syn. n.** The page priority of *Volucellobombus* is ignored because the male of *B. volucelloides* is unknown whereas both sexes are known in *B. robustus* Smith.

## NOTE ON GROUP-NAMES

A few of the names in the above list seem certainly to have been intended for groups of subgenera. Where a type has been fixed they would be available as subgeneric names though as it happens none has priority. Where a type has not already been fixed I have not done so. The concepts indicated by these names (sometimes emended during the present study) seem to be as follows:

*Anodontobombus* Krüger = Subgenera 1-22

*Boopobombus* Frison = Subgenera 6-9

*Odontobombus* Krüger = Subgenera 23-35

*Sulcobombus* Krüger = Subgenera 7-8

*Uncobombus* Krüger = Subgenera 10-14, possibly also 15-17. Originally subgenera 1 and 13-15.



CHARACTERS OF THE SUBGENERA OF *BOMBUS*

The order in which the subgenera are arranged below will perhaps be found convenient but it is not intended to have a very deep phylogenetic significance. It is very difficult to form a theory of the evolution of *Bombus*. The suggestion of Milliron (1961 : 50) that *B. mendax* Gerstäcker has Anthophorine affinities, whereas *B. fraternus* (Smith) arose from some Xylocopine stock seems to me fantastic. *Euglossa* and its allies are perhaps the non-social bees most similar to *Bombus*. If one regards short tongues and malar spaces as primitive, then the serrate mandible of *Alpigenobombus* which accompanies them is surely highly specialized; the habit of biting through the base of the corolla can scarcely be primitive. Nevertheless a long malar space is practically unknown in any other bee-genus (Michener, 1944 : 205 otherwise only in *Apis*, some *Trigona*, *Thrinchostoma*, and some *Colletes*).

On the grounds of nest-behaviour and brood-rearing, the section *Odontobombus* has been regarded as primitive (Sladen, 1912 : 43 ; Plath, 1934 : 119) but it is not certain that structural evolution has necessarily kept pace with evolution of social behaviour. The data recorded by Hobbs (1964) make it difficult to construct a combined phylogeny. Certain groups of subgenera seem clearly closer to one another structurally than to the others ; in the present arrangement such groups are: 1-2, 6-9, 13-16, 19-20, 23-25, 26-32, 34-35.

There are certain characters of subgeneric importance which have not been previously fully described or which require a scheme of nomenclature. Some terms have already been suggested in Richards (1927), others are noted below.

*Measurements* were made with a micrometer scale in the microscope eyepiece. Since in general only proportions are important the measurements are expressed in micrometer units which are equal to 0.073 mm. The following structures have been measured, ♀ length of malar space, proportions of antennal segments 3 : 4 : 5 ; ♂ length of malar space, proportions of antennal segments 3 : 4 : 5 : 8, length × greatest width of mid and hind basitarsus.

While the absolute length of the malar space is given, it is usually best to measure it against that of the third antennal segment. I have found it more satisfactory to measure its length as in Text-fig. 1 (cd) rather than obliquely (bd) as proposed by Krüger (1920 : 316, fig. B).

*Frons*. In the female, on each side of the frons, beside the lateral ocelli, are roundish, unpunctured areas (Text-fig. 2). Between these unpunctured areas and the eyes, lying along the inner orbit, is often a band of special sculpture. Krüger (1951 : 144) first showed the importance of these areas and it is illustrated by Moure & Sakagami (1962 : 85, fig. 1) in several species of *Fervidobombus* ; the sculpture is less specific in the males. In some subgenera a furrow, sometimes weak, transverses the top of the gena (temples) a little below the dorsal limit of the eyes. This will be termed the dorsal furrow of the gena. It is of minor subgeneric importance but in some groups it is a specific character of some value. It is best developed in *Pyrobombus* and absent in most *Odontobombus*. It is weaker in the males.

*The sting*. Various authors have pointed out the significance of the inner thickenings of the sting-sheath (= *incrustaciones vestibuli aculei*). The outer thickenings should also be examined, though less significant. The membrane between the

inner thickenings (presumably in the region of the genital orifice) is often thrown into characteristic folds; there are sometimes blackened patches in the membrane and, at least in *Pyrobombus*, these are not present in virgins and are scars produced during copulation by the male (probably by the sagittae) (Cumber, 1949 : 24). If the sting is fully extruded over the dorsal side of the abdomen, the sting-sheath forms a V of which the point is dorsal. In descriptions, the sting is described in this orientation and the essential parts are lettered in Text-fig. 3 (p. 223).

*The male genitalia.* The nomenclature of the male genitalia in Hymenoptera has been the subject of much controversy and I have earlier indicated a number of the alternatives (Richards, 1956). In the present work it has proved most convenient to use the old-fashioned nomenclature. The chief reason for this is that Snodgrass (1940 : 59-60) quoting Zander (1900 : fig. 5) gives evidence for believing that the lacinia and the squama are parts of one structure, the parameral spine. Nevertheless, it is essential for taxonomic purposes to distinguish them and to do this the old-fashioned terms seem the best; once using part of the system it then seems best to use the same nomenclatorial scheme throughout (Text-fig. 4).

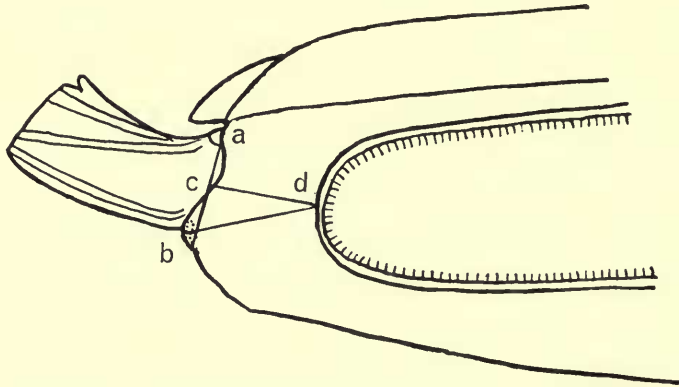


FIG. 1. Method of measuring length of malar space.

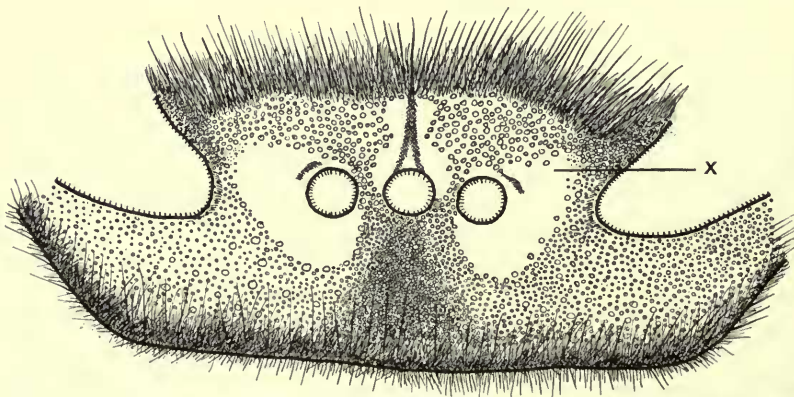


FIG. 2. Unpunctured areas (X) of frons of *Bombus terrestris* (Linnaeus), ♀.

I have only illustrated stings and male sternites and genitalia which have not been illustrated before. The scale lines are equal to 1.0 mm. for stings and to 2.5 mm. for the male sternites and genitalia.

### DESCRIPTIONS OF THE SUBGENERA

#### I. *ALPIGENOBOMBUS* Skorikov, 1914

##### *Mastrucatorbombus* Krüger, 1917

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line, median ocellus almost in a straight line with lateral ones. Frons moderately closely and strongly punctured, unpunctured areas large but ill-defined, with some large punctures on their outer part, a feebly developed band of fine punctures along the inner margin of eyes. Dorsal furrow of gena usually present. Antennal segments 3 : 4 : 5 as  $7\frac{1}{2}$  :  $4\frac{1}{2}$  :  $6\frac{1}{2}$ , segment 3 about twice to nearly three times as long as broad. Clypeus very transverse, swollen, closely but not very coarsely punctured throughout, apical impression very feeble, with rather dense punctures. Labral tubercles flattened, sharply truncate at inner end, furrow wide and deep, wider than length of antennal segment 3, lamella wide almost straight. Mandibles strongly curved, spoon-shaped, apex with six marginal teeth, incisura deep, no sulcus obliquus. Malar space short, very transverse, hardly longer than antennal segment 5 (=  $7-7\frac{1}{2}$ ), sometimes with some fine punctures. Mid basitarsus with posterior apical angle more or less distinctly acute. Hind tibia with corbicular surface bare, feebly reticulate, corbicular bristles normal, dorsal inner apical angle rather distinctly spinose, hind basitarsus with posterior dorsal angle obtusely spinose, surface not densely pubescent but in most species with some long bristles arising from lower edge and adjacent disk, especially proximally. Gastral tergite 6 reticulate or subrugose, sometimes with a feeble short furrow or very small posterior boss, short hairs not conspicuous. Sting with outer thickenings of sheath narrow and hardly widened above, inner thickenings a little widened below and gradually narrowed upwards, the degree of widening varying, centre or sometimes more of wide part blackened and membrane blackened on a lateral lobe projecting down to about mid point. Wings hyaline or in eastern species blackish.

♂. Eyes not swollen, ocelli separated by three diameters from eyes, lying almost on the postocular line. Antennae not very long, penultimate segments not curved, segments 3 : 4 : 5 : 8 = 7 :  $4\frac{1}{2}$  :  $6\frac{1}{2}$  : 6. Mandibles with a broad ventral and two small dorsal teeth, beard long and dense. Malar space transverse, shorter than antennal segment 5 (= 6). Mid basitarsus moderately long and parallel-sided ( $40 \times 9$ ), posterior edge with quite numerous long bristles, anterior edge also with a few. Hind tibia considerably widened distally, moderately convex, shining with large bare distal disk, both edges with very long hairs. Hind basitarsus  $40 \times 12$ , dorsal apical angle subacute, dorsal edge with a few long bristles. Gastral sternite 6 scarcely modified, a little truncate. Gastral sternite 7 wide, widely produced, end somewhat truncate, no fenestrae, bristles short and inconspicuous. Gastral sternite 8 strongly produced, produced part with sides somewhat convergent, end obtusely angulated, one central line, bristles short and dense. Genitalia rather long and narrow, stipes with a deep, wide inner impression; sagittae narrow, much wider in side view, especially towards base which is followed by a ventral emargination forming a blunt tooth, apex bent down and hooked inwards, hook rather wide, tip rounded, outer edge with a narrow nearly straight flange, proximal end of flange projecting a little; spatha with sides strongly converging, at mid-point two and a half to three times as wide as sagitta; squama rounded quadrate or pointed inwards, proximal inner lobe narrow and separated from main lobe by a narrow emargination; lacinia projecting well beyond squama, curved, parallel-sided, end emarginate with inner angle acute, with a small bristle-tuft; volsella region with or without dense bristles.

Illustrations. ♀ sting—Hazeltine & Chandler 1964 : pl. 6. ♂ Gastral sternite 7 and 8—Pittioni, 1939a : pl. 3, fig. 5; Frison, 1935 : figs. 5d, e, 6e, f. Genitalia—Krüger, 1920 : pl. 6, fig. q; Pittioni, 1939a : pl. 3, fig. 5; Frison, 1935 : figs. 5b, 6c.

N.W. SPAIN, PYRENEES, ALPS and NORWAY to CHINA and HIMALAYAS.

2. *NOBILIBOMBUS* Skorikov, 1933

(Text-figs. 3-6)

Skorikov (1933a : 62) published a new subgenus, *Nobilibombus*, including three species, *B. nobilis* Friese, *B. validus* Friese, and the later described *B. morawitzii* Skorikov. No male was known. No type-species of the subgenus was fixed but under the International Code of Zoological Nomenclature, Art. 68(c), *B. nobilis* Friese can be regarded as the type-species by virtual tautonymy.

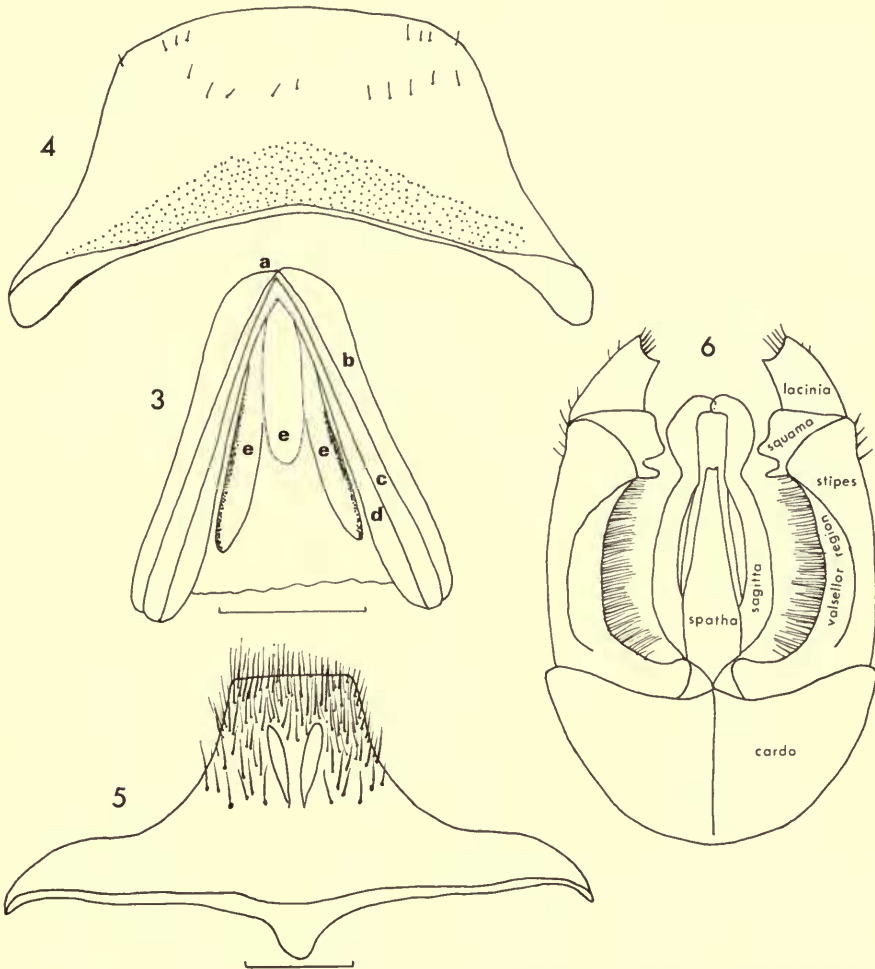
Friese's description (1904) 1905 : 513) mentions that the mandibles have four to five teeth and the species is recorded from several localities in W. China (8 ♀, 6 ♂). On p. 510, *B. validus* is stated to have untoothed mandibles. Nevertheless, in the review of palearctic species (pp. 516-523), he places (p. 517) *B. validus* in a group with *B. mastrucatus* Gerstäcker which he says has a short malar space and toothed mandibles. On the other hand, *B. nobilis* (p. 519) is placed in a group with *B. lapidarius* (Linnaeus) among the species in which the mandibles are untoothed. Dr. B. Tkalců has seen a "type ♀" of *B. nobilis* from Friese's collection and it is a species of subgenus *Melanobombus* von Dalla Torre [= *B. pyrosoma* Morawitz, 1890 ssp. *hönei* Bischoff, 1936]. It seems quite likely that Friese's series was mixed and that this led to the confusion already noted in the description. It seems difficult to believe that Skorikov could have erected the subgenus *Nobilibombus* for species with toothed mandibles and with malar space longer than in *Alpigenobombus*, unless most of Friese's specimens (now at Leningrad) had these characters. Unfortunately it has not proved possible to examine the whole series or indeed any specimen other than the one retained by Friese.

The characters of the subgenus given below are taken from *B. sikkimi* Friese and its differentiation from other subgenera will be seen in the keys (pp. 260, 265).

♀. Ocelli separated by about three diameters from eyes, lying well in front of the postocular line, median ocellus almost in line with the lateral ones. Frons with fine and indistinct though fairly numerous punctures, especially along inner margins of eyes, unpunctured areas small and ill-defined. Dorsal furrow of gena present but usually very weak. Antennal segments 3 : 4 : 5 = 10½ : 5 : 7, segments 3 about three times as long as wide in centre. Clypeus about quadrate, rather swollen, with scattered sparse punctures of variable size, apical impressions moderate, with rather close, large punctures. Labral tubercles considerably raised, angulated at inner end, shining and coarsely punctured, furrow rather narrow, less wide than length of antennal segment 3, lamella nearly straight, almost as wide as a tubercle. Mandibles with six apical teeth, the ventral one at bottom of the incision large and directed downwards, almost at right angles to the others, no sulcus obliquus. Malar space quadrate, longer than antennal segment 3 (= 15). Mid basitarsus with posterior apical angle spinosely produced, whole surface with relatively long bristles and on basal half with very long, obliquely erect ones. Hind tibia with corbicular surface bare, very feebly reticulate, corbicular bristles normal, dorsal inner apical angle scarcely produced. Hind basitarsus posterior dorsal angle acute, surface rather densely pubescent, dorsal edge with moderately short dense bristles, ventral part of disk and lower edge with long bristles, especially on basal half, almost like those of corbicle. Gastral tergite 6 somewhat truncate. Characters of sting (Text-fig. 3) essentially similar to *Alpigenobombus*. Wings subhyaline.

♂. Eyes not swollen, ocelli separated by three diameters from eyes, lying about on the postocular line. Antennae not very long, penultimate segments not curved, segments 3 : 4 : 5 : 8 = 7½ : 5½ : 7 : 7. Mandibles with a distinct ventral and two small dorsal teeth, the most

dorsal one not very distinct, beard long and dense. Malar space distinctly longer than broad, longer than antennal segments 2 + 3 but shorter than 3 + 4 (= 12). Mid basitarsus long and parallel-sided ( $45 \times 11$ ), margins especially posterior one with many long hairs. Hind tibia distally a little concave with a large bare disk, both margins and proximal half of disk with very long bristles, at least twice as long as its greatest width. Hind basitarsus  $50 \times 13$ , dorsal apical angle just acute, surface with dense, tomentum-like hairs and on disk many very long bristles especially on margins. Gastral sternite 6 with apical margin rounded and a little thickened with a dense short postapical fringe. Gastral sternite 7 (Text-fig. 4) very widely crescentic (i.e. long in longitudinal direction), no lines or fenestrae, one long bristle on each side. Gastral sternite 8 (Text-fig. 5b) strongly produced, sides feebly convergent, distal angles almost rounded, apex truncate or feebly curved, no fenestrae but distal half with two lines enclosing a very narrowly pyriform area, surface with dense short bristles. Genitalia (Text-fig. 6) large and rather long, stipes with a wide sharply defined impression, sagittae narrow,



FIGS. 3-6. *Bombus sikkimi* Friese. 3, sting : a, dorsal end of sting ; b, outer thickening of sheath, c ; d, inner thickening ; e, folds in membrane. 4, gastral sternite 7 of ♂ ; 5, gastral sternite 8 of ♂ ; 6, ♂ genitalia, the essential parts labelled.

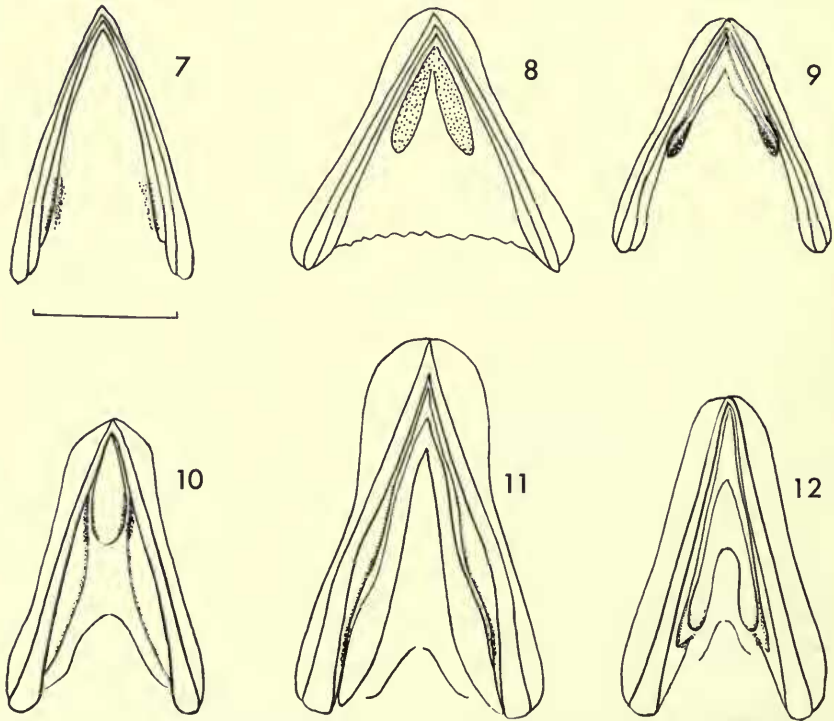
in side view with a small ventral tooth at end of postbasal emargination, apex bent downwards and hooked inwards, apex of hook just blunt, outer side with a moderate flange which widens anteriorly but does not form a tooth ; spatha wide, sides strongly convergent, at centre 2-3 times as wide as adjacent sagitta ; squama very transverse, inner side much wider than outer side, an inner projection forming a rounded-squarish lobe, extending some way beyond the stipes, and separated from this a narrow emargination a small proximal lobe ; lacinia extending some way beyond the squama, wide, feebly curved and parallel-sided, outer edge raised into a keel just inside the edge, apex feebly emarginate, outer corner rounded, inner one forming a feeble tooth ; volsellar region with dense, moderately long bristles.

Illustrations. Sting—Text-fig. 3. Gastral sternites 7 and 8—Text-figs 4 and 5. Genitalia—Text-fig. 6.

HIMALAYAS (s.l.) (W. INDIA TO N. CHINA).

### 3. *ORIENTALIBOMBUS* Richards, 1929

♀. Ocelli separated by nearly three diameters from eyes, lying well in front of postocular line. Frons with a large unpunctured area around the ocelli, only a few fine punctures in front of each lateral ocellus and some rather fine punctures along inner margins of eyes. Dorsal furrow of gena sometimes feebly developed posteriorly. Antennal segments 3 : 4 : 5 = 10 : 6½ : 7½, segment 3 about two and a half times as long as broad. Clypeus elongate, swollen, little punctured, apical impressions feeble, little punctured. Labral tubercles angularly convex but not specially so at inner angles, furrow wide, wider than length of antennal segments 2 + 3, lamella wide, nearly straight. Mandibles with no incisura, salcus obliquus well-marked



FIGS. 7-12. Stings of 7, *Bombus funerarius* Smith ; 8, *B. mendax* Gerstäcker ; 9, *B. vorticosis* Gerstäcker ; 10, *B. pressus* (Frison) ; 11, *B. eximius* Smith ; 12, *B. robustus* Smith.

(weaker in *B. funerarius* Smith). Malar space very long, longer than antennal segments 2 + 3 (= 19). Mid basitarsus with posterior apical angle obtuse. Hind tibia with corbicular surface bare, surface not reticulate, corbicular bristles normal, dorsal inner apical angle rather obtusely produced. Hind basitarsus broad, slightly narrowed to the apex, dorsal apical angle just acute, surface with fine bristles not dense, marginal bristles short and dense. Gastral tergite 6 sometimes with a feeble posterior furrow, its short hairs directed inwards. Sting with outer thickenings of sheath of moderate, even width, inner thickening moderately widened below and narrowing gradually above, lower part of inner edge blackened for a considerable distance and the adjacent membrane also blackened. Wings dark.

♂. Eyes not swollen, ocelli separated by three diameters from eyes, lying just in front of postocular line. Antennae very long, penultimate segments each a little curved, segments 3 : 4 : 5 : 8 =  $7\frac{1}{2}$  :  $8\frac{1}{2}$  :  $11\frac{1}{2}$  : 13. Mandibles with a broad ventral and one small dorsal tooth, beard long and dense. Malar space much longer than broad, a little longer than antennal segments 2 + 3 but shorter than 3 + 4 (=  $13\frac{1}{2}$ ), or in *B. funerarius* Smith a little longer than 3 + 4 (= 14), not punctured. Mid basitarsus long and broad ( $48 \times 13$ ), fringes short. Hind tibia considerably widened and flattened distally, disk bare, fringes moderately dense but only a few bristles as long as maximal tibial width (fringes longer in *B. funerarius* Smith). Hind basitarsus  $49 \times 15$ , apical angle just acute, hairs of surface not dense, fringes short. Gastral sternite 6 with end thickened and recurved, especially on central quarter, followed by a membrane and a long, rather dense fringe, still longer at each side. Gastral sternite 7 forming a wide transverse band with anterior and posterior margins subparallel, latter feebly bisinuate, surface with sparse, scattered, short bristles. Gastral sternite 8 in the form of narrow band produced into a very wide tongue-shaped process, sides slightly rounded and angles just rounded, apex very feebly emarginate, surface densely covered with short bristles, three small fenestrae on mid-line (except in *B. funerarius* Smith). Genitalia very large and rather elongate, stipes broad with a wide, fairly well-defined impression; sagittae narrow and very little wider in side view, with a strong recurved tooth near mid-point beneath, apex somewhat downcurved, ending in a long point, with a very slight flange on outer edge; spatha narrow, hardly wider than sagitta; squama large, transverse, somewhat wider on inner than outer-side, projecting in a little past the stipes, all angles rounded; lacinia mostly narrow, parallel-sided, curving inwards, projecting well beyond squama, apex curved over inwards and truncate, dorsal corner acute, from base of lacinia and hidden by the squama arises a long, complex, pointed process; or, in *B. funerarius* Smith, lacinia forms a long acute process and beneath the squama bears a small equilateral triangular process; volsella region with dense, moderately long hairs.

Illustrations. Sting—Richards, 1929 : fig. 3 ; Text-fig. 7. Gastral sternites 7 and 8—Frison, 1935 : figs. 4d, e, b, 7d, e ; Richards, 1929 : fig. 1. Genitalia—Richards, 1929 : fig. 3 ; Frison, 1935 : fig. 7c.

HIMALAYAS, S.W. CHINA. *Bombus funerarius* Smith (♂ = *Bremus priscus* Frison, 1935) is unusually distinct but probably best included.

#### 4. *KALLOBOMBUS* von Dalla Torre, 1880

*Soroensibombus* Vogt, 1911

♀. Ocelli separated by rather more than three diameters from eyes, lying almost behind the postocular line. Frons rather closely but not very strongly punctured, unpunctured areas small but well-defined, a wide band of fine punctures along inner margins of eyes. Dorsal furrow of gena just indicated. Antennal segments 3 : 4 : 5 = 7 : 5 :  $5\frac{1}{2}$ , segment 3 about twice as long as broad. Clypeus rather short and swollen, rather strongly and evenly punctured, apical impressions strongly but not more closely punctured. Labral tubercles not much raised, moderately angled at inner end, furrow narrow, not as broad as length of antennal segment 3, lamella short and curved, inconspicuous. Mandibles with no incisura or salcus

obliquus. Malar space just transverse, a little longer than antennal segment 3 (= 8). Mid basitarsus with posterior apical angle obtuse. Hind tibia with corbicular surface bare, surface moderately reticulate, dorsal inner apical angle not produced. Hind basitarsus with dorsal angle moderately acute, surface not densely haired, bristles rather short. Gastral tergite 6 feebly sculptured, rather shining. Sting with outer thickening of sheath moderately wide, especially above, inner thickenings widening rather strongly upwards to above middle, then suddenly narrowed, wide part a little blackened at its edge, no black spots in membrane but a slight dorsal fold. Wings evenly but not strongly infusate.

♂. Eyes not swollen, ocelli separated by fully three diameters from eyes, lying just behind the postocular line. Antennae, long, penultimate segments each a little curved, segments 3 : 4 : 5 : 8 =  $4\frac{1}{2}$  :  $5\frac{1}{2}$  :  $6\frac{1}{2}$  : 7. Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space quadrate, longer than antennal segments 2 + 3, shorter than 3 + 4 (= 7), not punctured. Mid basitarsus not very long, nearly parallel-sided but a little narrowed at each end ( $37 \times 8$ ), fringes short. Hind tibia moderately convex, with a considerable shining, nearly bare disk, fringes long, especially the dorsal one. Hind basitarsus  $34 \times 10$ , considerably narrowed at base, apical angle just acute, fringes short. Gastral sternite 6 a little produced on central quarter, not recurved, scarcely thickened, with a short postapical fringe. Gastral sternite 7 strongly produced, sides of produced part with a large submembranous, transparent area, apex shallowly emarginate, with a narrow band of dense bristles of which some on each side are longer. Gastral sternite 8 produced, production relatively narrow and parallel-sided, angles rounded, apex scarcely emarginate, a considerable area of dense short bristles, no fenestra but two parallel lines meeting before apex. Genitalia markedly elongate, stipes with no real inner impression; sagittae narrow, bent down at apex, hooked outwards, hook forming a sort of half arrowhead, tip rounded (*proteus* Gerstäcker) or pointed (*soroeeensis* (Fabricius)), tip of hook pointed, sagitta also narrow in side view but with a large isolated pointed tooth beneath centre; spatha wide, sides strongly converging, at centre three times as wide as sagitta; squama elongate, almost twice as long as broad, inner edge with a shallow emargination, all corners rounded; lacinia long, curved inwards, projecting well beyond squama, apex emarginate, outer corner sharp, inner one forming a curved, feebly serrate hook, between them a small tuft of bristles; volsella regions with dense short hairs.

Illustrations. Sting—Richards, 1927: fig. 54; Hazeltine & Chandler, 1964: pl. 6. Gastral sternites 7 and 8—Radoszkowsky, 1884: fig. 34c; Pittioni, 1939a: pl. 2, fig. 6. Genitalia—Krüger, 1920: pl. 7, fig. u; Richards, 1927: fig. 54; Pittioni, 1939a: pl. 2, fig. 6.

EUROPE and adjacent parts of ASIA.

### 5. *BOMBUS* Latreille, 1802a (s.s.)

*Leucobombus* von Dalla Torre, 1880

*Terrestribombus* Vogt, 1911

♀. Ocelli separated by nearly three diameters from eyes, lying just in front of postocular line. Frons with numerous punctures, mostly fine and coarse mixed, with well-defined unpunctured areas and a band of close, mostly fine punctures along inner margins of eyes. Dorsal furrow of gena absent or very weak; a little stronger in *B. ignitus* Smith. Antennal segments 3 : 4 : 5 = 9 : 6 : 7, segment 3 twice as long as broad. Clypeus short, convex, closely and rather strongly punctured throughout and especially closely in the well-marked apical impressions. Labral tubercles flattened, angled at inner end, furrow narrow, less wide than length of antennal segments, lamella short, somewhat curved. Mandibles with a strong incisura and moderately distinct sulcus obliquus. Malar space transverse, shorter than antennal segments 2 + 3 (= 9). Mid basitarsus with posterior apical angle obtuse. Hind tibia with corbicular surface bare, very weakly reticulate, dorsal inner apical angle distinctly produced. Hind basitarsus with dorsal angle just acute, surface densely pubescent, bristles short. Gastral tergite 6 feebly sculptured, rather shining. Sting with outer thickenings of sheath narrow but



broadened dorsally, inner thickenings rather wide and twice emarginate, membrane between thrown into central and lateral folds. Wings moderately or in some species strongly infusate.

♂. Eyes not swollen, ocelli separated by three diameters from eyes, lying on the postocular line. Antennae of moderate length, segments  $3 : 4 : 5 : 8 = 7 : 5 : 6 : 6\frac{1}{2}$ . Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space almost transverse, longer than antennal segment 3 but shorter than  $2 + 3 (= 9)$ , with some fine punctures. Mid basitarsus relatively broad and parallel-sided ( $46 \times 12$ ), fringes short. Hind tibia slightly convex but somewhat hollowed out towards dorsal margin, bare after proximal quarter, fringes, especially the dorsal one, long. Hind basitarsus  $45 \times 15$ , distal angle just acute, fringes short. Gastral sternite 6 with margin considerably recurved and thickened and with a dense short postapical fringe. Gastral sternite 7 very transverse, posterior margin rounded with a central emargination, a group of 3-5 long bristles on each side, no lines or fenestrae. Gastral sternite 8 broad, produced, trapeziform, sides strongly converging, apex weakly emarginate with corners angled, tufts of long bristles arising near these angles, no lines or fenestrae. Genitalia with very slight inner impressions on stipes; sagittae narrow in dorsal view but undulating and widely flaring at apex, in side view very wide, deeply emarginate beneath just after base, apex widened and somewhat curved outwards, spatha wide, at least four times as wide as dorsal width of sagitta; squama very transverse with an anterior submembranous inner projection separated from the main lobe by a deep emargination, main lobe expanded inwards in a more or less trumpet-shaped projection; lacinia projecting very little beyond squama, end part transverse, strongly produced inwards into a process ending in a slight upturned hook, hind margin somewhat roughened and with dense pubescence; volsella region with short, rather sparse hairs.

Illustrations. Sting—Franklin, 1913 : figs. 149, 169, 176; Richards, 1927 : fig. 55; Tkalců, 1963 : figs. 13-15; Hazeltine & Chandler, 1964 : pl. 3. Gastral sternites 7-8—Franklin, 1913 : figs. 111, 113, 128, 135; Richards, 1927 : figs. 21, 23; Pittioni, 1939a : pl. 3, fig. 1. Genitalia—Franklin, 1913 : figs. 119, 120; Richards, 1927 : figs. 15-27; Krüger, 1920 : pl. vii t; Pittioni, 1939a : pl. 3, fig. 1.

HOLARCTIC and parts of S.E. and S.W. ASIA.

## 6. *FRATERNOBOMBUS* Skorikov, 1922

♀. Ocelli separated by two diameters from eyes, lying well in front of postocular line. Frons shining, mostly with rather fine not very close punctures, fine and very close in an area behind the ocelli and coarser and less close in front of them, unpunctured areas large and ill-defined, no distinct band of denser fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 10 : 5 : 6\frac{1}{2}$ , segment 3 twice as long as broad. Clypeus short, transverse, swollen but rather flattened on ventral third, with large but rather sparse and shallow punctures except on disk below, punctures close and deeper in a large region surrounding the apical impressions which are themselves feeble and ill-defined. Labrum with strongly convex tubercles forming smooth rounded knobs at inner end, furrow deep, a little wider than length of antennal segment 3, lamella strongly curved, half as wide as labrum. Mandibles with no incisura and a strong sulcus obliquus. Malar space very transverse, about as long as antennal segment 5 ( $= 7$ ). Mid basitarsus with posterior apical angle rounded. Hind tibia with corbicular surface bare, not reticulate, dorsal fringe unusually short and dense, mostly shorter than half apical width of tibia, dorsal inner apical angle long and acute. Gastral tergite 6 granulate with a subapical somewhat flattened shining triangle. Sting with outer thickenings of the sheath narrow and of even width, inner thickenings considerably widened and blackened on lower third, then very narrow, membrane not differentiated. Wings evenly dark fuscous.

♂. Eyes considerably swollen and reaching nearer to occipital margin than usual, ocelli separated by less than  $\frac{1}{2}$  diameter from eyes, very far in front of postocular line. Antennae rather long, segments  $3 : 4 : 5 : 8 = 9 : 5 : 7 : 8$ . Mandibles with one broad ventral and one smaller dorsal tooth, beard feeble, very short. Malar space absolutely linear, shorter than

antennal segment 2 ( $= 2\frac{1}{2}$ ). Mid tibia wide, flattened, longitudinally hollowed out beneath. Mid basitarsus long, parallel-sided ( $66 \times 15$ ), posterior fringe short and dense. Hind tibia convex, mostly densely hairy but with a more posterior streak which is shining, with sparse short hairs, both fringes very short. Hind basitarsus  $65 \times 17$ , long, narrow, parallel-sided, distal angle a right angle, fringes short. Gastral sternite 6 flattened with a feeble preapical transverse thickening. Gastral sternite 7 very large, trapeziform, almost quadrate, apex with a deep semicircular emargination covering more than half its width, a wide band of very short dense bristles on each side, no lines or fenestrae. Gastral sternite 8 large, strongly produced, apex with recurved corners and margin weakly trisinate, a moderate patch of short bristles on each side, two parallel lines on disk posteriorly. Genitalia large and elongate, inner impressions of stipes distinct but rather narrow; sagittae narrow and not much wider in side view, no tooth beneath, apex hooked inwards and outer side of hook considerably expanded by a flange which is hardly perceptibly serrate; spatha narrow, hardly wider than sagitta except right at base; squama rather long, outer and posterior margins forming a continuous curve, inner margin with a strong emargination forming a rather blunt projecting hook at anterior inner end; lacinia elongate, projecting some way beyond squama, pointed, outer edge raised and thickened, inner edge flattened, thin and approximately straight, irregularly crenate, short haired. Volsella region bare.

Illustrations. Sting—Hazeltine & Chandler, 1964: pl. 2. Gastral sternites 7 and 8—Franklin, 1913: figs. 1, 22. Genitalia—Franklin, 1913: figs. 71, 87.

NORTH and CENTRAL AMERICA.

## 7. *CONFUSIBOMBUS* Ball, 1914

*Sulcobombus* Krüger, 1917

*Confusobombus* Krüger, 1917

♀. Ocelli separated by about two and a half diameters from eyes, lying well in front of postocular line. Frons mostly closely and rather finely punctured, unpunctured areas well-defined, a wide band of close fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 11 : 5\frac{1}{2} : 5\frac{1}{2}$ , segment 3 between three and four times as long as broad. Clypeus moderately elongate, strongly swollen but with a wide flattened disk, closely and finely punctured, even more closely on lower third, apical impressions ill-defined but closely punctured. Labrum with tubercles little raised, much rounded, furrow wide and shallow though not quite so wide as length of antennal segment 3, lamella small, inconspicuous, curved. Mandibles with no incisura, sulcus obliquus moderately strong. Malar space a little longer than broad ( $= 11$ ), a little longer than antennal segment 3. Mid basitarsus with posterior apical angle rounded. Hind tibia with corbicular surface bare, moderately reticulate, inner dorsal apical angle short but pointed. Gastral tergite 6 moderately shining, finely granulate. Sting with outer thickenings of the sheath rather narrow but a little broader above than below, inner thickenings very narrow, intervening membrane convex above and sending to centre a large blackened lobe on each side. Wings evenly but not strongly infusate.

♂. Eyes swollen, temples narrow, ocelli separated by rather more than one diameter from eye, far in front of postocular line. Antennae short, segments  $3 : 4 : 5 : 8 = 7 : 3\frac{1}{2} : 4 : 6$ . Mandibles with a broad ventral and a small dorsal tooth, beard moderately long and dense. Malar space strongly transverse, shorter than antennal segment 3 ( $= 5\frac{1}{2}$ ), almost unpunctured. Mid basitarsus moderately long and parallel-sided ( $= 42 \times 10$ ) posterior fringe about as wide as tarsus. Hind tibia thick and rather clavate, convex, surface punctured and cross-striate with short hairs on its whole surface, fringes long dorsally, mostly short ventrally. Hind basitarsus  $37 \times 12$ , moderately broad and narrowed to base, apical dorsal angle rounded, dorsal fringe long, ventral one short. Gastral sternite 6 strongly recurved, a little thickened and emarginate. Gastral sternite 7 crescentic but considerably produced into a rounded triangle, with a band of scattered short bristles well before apex, no lines or fenestrae. Gastral sternite 8 generally crescentic, little produced, feebly truncate, angles rounded, one long black

bristle only from a black spot on each side, no lines, two minute oval fenestrae on disk. Genitalia small, pyriform; stipes very broad with deep sharp-edged impressions covering less than half their width; sagittae in dorsal view moderately narrow, dorsal half pale on apical half, at mid point with a lateral, somewhat ventral, tooth, beyond this finger-shaped, hardly narrowed, feebly serrate externally, considerably bent down, in side view at least twice as wide as in dorsal view, somewhat narrowing distally; spatha very wide, at centre five times as wide as sagitta, but strongly narrowing distally; squama elongate, bent into a V-shaped plate, the spine of the V forming the outer edge, the inner edge having dorsal and ventral plates, spine subacute distally, lower plate with posterior and inner edge rounded together, upper plate with a feeble bilobed process adjacent to stipes; lacinia long, pointed, inner edge opposite end of squama produced into a stout, backward-curving tooth, outer edge with short stout dense bristles, inner edge with similar but less dense and stout bristles; volsella region with a moderate number of not very long and stout bristles.

Illustrations. Sting—Hazeltine & Chandler, 1964: pl. 5. Gastral sternites 7 and 8—Radoszkowsky, 1884: 42c; Pittioni, 1939a: pl. 4, fig. 2. Genitalia—Krüger, 1920: pl. 7, fig. r; Pittioni, 1939a: pl. 4, fig. 2.

#### EUROPE.

### 8. *MENDACIBOMBUS* Skorikov, 1914

♀. Ocelli separated by two and a half diameters from eyes and lying just in front of postocular line. Frons finely and rather closely punctured, unpunctured areas well-defined, of moderate size, a band of fine punctures along inner margin of eyes. Dorsal furrow of gena sometimes feebly indicated. Antennal segments 3 : 4 : 5 = 11 : 4 : 5, segment 3 nearly four times as long as broad. Clypeus very elongate, swollen, feebly punctured, apical impressions feeble and little punctured. Labrum with tubercles little raised, smooth and rounded, gradually narrowed and depressed inwards, furrow very wide and ill-defined, perhaps better described as a transverse furrow both above and below the little raised tubercles, lamella wide, straight. Mandibles with no incisura or sulcus obliquus. Malar space very elongate (= 14), longer than antennal segments 2 + 3. Mid basitarsus with posterior apical angle rounded. Hind tibia with basal half of corbicular surface covered with bristles, bare part densely reticulate, dull, inner dorsal apical angle not produced, hind basitarsus with long bristles on dorsal edge. Gastral tergite 6 shining, moderately closely and strongly punctured. Sting with outer thickenings of sheath very narrow, inner thickening also very narrow, not blackened, membrane undifferentiated. Wings evenly but very little infusate.

♂. Eyes considerably swollen and reaching back to near the occipital margin, ocelli separated by one diameter from eyes, far in front of postocular line. Antennae rather long, segments 3 : 4 : 5 : 8 = 12½ : 4½ : 6 : 6½, segment 3 at least four times as long as broad. Mandibles rather wider than usual, ending in a single wide tooth only in *B. mendax* Gerstäcker but with a smaller, more dorsal tooth in some Asiatic species, beard long and dense. Malar space very elongate, just shorter than antennal segment 3 (= 11), practically unpunctured. Mid basitarsus moderately long and broad (= 41 × 10), fringes mostly short but a few long bristles near base. Hind tibia slightly convex, rather dull, whole surface covered with not very close short feathered bristles, fringes very long. Hind basitarsus 34 × 15, rather short and broad, dorsal margin with many long hairs, apical dorsal angle rounded-acute. Gastral sternite 6 a little truncate with dense short pale pubescence along apex. Gastral sternite 7 crescentic with a wide produced piece which is about two and a half times as wide at apex as long, sides considerably converging, margin widely membranous, whole surface with scattered, mostly short bristles, no lines or fenestrae. Gastral sternite 8 produced in centre into a large subquadrate piece of which the sides are feebly rounded, apex rather deeply emarginate, surface with dense short bristles, no lines or fenestrae. Genitalia with stipes short and stout with very slight inner impression; sagittae rather narrow on proximal half, still more so distally where eventually pointed, in side view bisinuate and very little wider, margin weakly crenate a little before apex, apical half on inner side with distinct hairs; spatha moderately wide,

rather more than twice as wide as basal part of sagitta ; squama stout and dark, not produced inwards, in half side view quadrate with rounded angles, a little longer than broad ; lacinia elongate, projecting some way beyond squama, rounded-pointed with inner edge more truncate or a little concave, with stout, curved, rather short bristles on its outer edge ; volsella region bare.

Illustrations. Sting—Text-fig. 8. Gastral sternites 7 and 8—Pittioni, 1939a : pl. 4, fig. 3. Genitalia—Krüger, 1920 : pl. 7, fig. s ; Pittioni, 1939 : pl. 4, fig. 3.

High mountains of EUROPE and ASIA.

### 9. *BOMBIAS* Robertson, 1903

*Nevadensibombus* Skorikov, 1922

♀. Ocelli separated by rather more than two diameters from eyes and lying far in front of postocular line. Frons moderately finely and closely punctured, unpunctured areas large and ill-defined, a band of fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 = 11 : 5 : 6, segment 3 three times as long as broad or rather less. Clypeus elongate, strongly swollen, especially dorsally, finely and evenly punctured, apical impressions feeble and scarcely more punctured. Labrum with tubercles wide and much flattened, furrow ill-defined and shallow but essentially narrow, lamella very wide with a shining thickened edge, surmounted by dense pubescence. Mandibles with no incisura and a feeble sulcus obliquus. Malar space about quadrate (= 12-15), a little longer than antennal segment 3. Mid basitarsus with posterior apical angle rounded. Hind tibia with corbicular surface bare, weakly reticulate, inner dorsal apical angle feebly produced, hind basitarsus with only short pubescence. Gastral tergite 6 finely granulate, rather dull. Sting with outer thickenings of sheath a little wider above than below, inner thickenings rather narrow, of almost even width throughout, edge recurved especially below, membrane undifferentiated except for some lateral blackening below. Wings infuscated.

♂. Rather large, eyes strongly swollen, temples narrow, ocelli separated by one quarter their diameter from eye, very far in front of postocular line. Antennae rather long, segments 3 : 4 : 5 : 8 =  $8\frac{1}{2}$  :  $4\frac{1}{2}$  : 5 : 5, penultimate segments not curved. Mandibles with a broad ventral and a small dorsal tooth, beard very sparse. Malar space very transverse (= 5), about as long as antennal segment 5, with a few microscopic punctures. Mid basitarsus long and broad ( $48 \times 13$ ), posterior apical angle rounded, dorsal fringe long. Hind tibia considerably clavate, somewhat concave, moderately shining but strongly cross-striate, whole surface with moderately numerous, very short hairs, fringes short. Hind basitarsus ( $47 \times 17$ ), dorsal fringe long, apical dorsal angle rounded. Gastral sternite 6 somewhat depressed with apex recurved, with a dense short fringe. Gastral sternite 7 broadly produced, sides anteriorly diverging, apex truncate, feebly emarginate, angles moderately distinct, a distal patch of very short bristles, no lines or fenestrae. Gastral sternite 8 broadly triangular (no tongue-like projection), apex deeply emarginate and with a U-shaped line defining a still deeper membranous area which is not actually emarginate, two apical patches of short bristles, no other lines or fenestrae. Genitalia with stipes broad at apex, inner impressions hardly developed ; sagittae in dorsal view narrow, a little downcurved, posterior third outwardly feebly serrate, apex more or less pointed (no hooks or flanges), in side view hardly wider, no ventral tooth or emargination ; spatha very wide, five times as wide as sagitta, only narrowing just before its end ; squama large, subquadrate, sloping obliquely downwards laterally, all angles rounded ; lacinia relatively narrow, projecting far beyond the squama, apex subtruncate with a slight hook at inner end, whole surface and outer and inner margin with short, rather dense hairs ; no long bristles in volsellar regions.

Illustrations. Sting—Hazeltine & Chandler, 1964 : pl. 2 ; Franklin, 1913 : fig. 151. Gastral sternites 7 and 8—Franklin, 1913 : figs. 100, 124, 136, 139. Genitalia—Franklin, 1913 : figs. 73, 82, 83.

N. AMERICA.

10. *SEPARATOBOMBUS* Frison, 1927

♀. Ocelli separated by two diameters or rather less from eyes and lying well in front of postocular line. Frons rather strongly and closely punctured, unpunctured areas small and well-defined, a band of fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 9 : 4\frac{1}{2} : 5\frac{1}{2}$ , segment 3 twice as long as broad. Clypeus rather long and swollen, finely and moderately closely punctured, apical impressions feeble, more closely punctured. Labrum with tubercles, flattened, angled at inner end, furrow wide and deep, nearly as wide as length of antennal segment 3, lamella wide, curved. Mandibles with no incisura but with a strong sulcus obliquus. Malar space short and transverse (= 8), shorter than antennal segment 3. Mid basitarsus with posterior apical angle rounded. Hind tibia with corbicular surface bare, distinctly reticulate, inner dorsal apical angle distinctly but not strongly produced, hind basitarsus with only short pubescence. Gastral tergite 6 shining, feebly granulate. Sting with outer thickenings of sheath moderately wide both above and below, inner thickenings rather strongly widened on lower third, then narrowed in a smooth curve and thence upwards of an even width, a little blackened where it narrows, membrane projecting above and produced downwards on each side into an elongate-oval lobe which is blackened at the end. Wings infuscate at tip or throughout.

♂. Rather large, eyes swollen, temples rather narrow, ocelli separated by two thirds their diameter from eyes, far in front of the postocular line. Antennae rather long, segments  $3 : 4 : 5 : 8 = 7\frac{1}{2} : 5\frac{1}{2} : 7 : 7\frac{1}{2}$ , penultimate segments scarcely curved. Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space very short and transverse (=  $3\frac{1}{2}$ ), hardly longer than antennal segment 2, shorter than 4, hardly punctured. Mid basitarsus long and parallel-sided ( $45 \times 9\frac{1}{2}$ ), posterior apical angle rounded, fringes short. Hind tibia not very convex, dull and alutaceous, large disk almost completely bare, dorsal fringe long. Hind basitarsus ( $42 \times 10$ ) dorsal fringe long, fully twice as long as tibial width, apical dorsal angle a rounded right angle. Gastral sternite 6 with apex a little thickened, not recurved, with short dense postapical fringe. Gastral sternite 7 trapeziform, apex very feebly emarginate, corners rounded but slightly projecting, a large area of short dense bristles, no lines or fenestrae. Gastral sternite 8 subtriangularly produced, sides strongly converging, apex a little rounded, almost pointed, a large area of dense, short bristles, with two parallel lines which meet at centre and then proceed back as one line, no fenestrae. Genitalia rather broad, stipes with wide but very poorly defined impressions; sagittae in dorsal view narrow, apex curved downwards, widely hooked inwards, tip of hook not really acute and its outer edge with a slight flange, in side view about twice as wide, with no ventral tooth or emargination, spatha small, sides strongly converging, at its centre two and a half times as wide as sagitta; squama small, transverse, rounded-triangular, with a small inner process separated by a shallow emargination where it joins the stipes; lacinia short, only just projecting beyond the squama, with an acute outer angle and a moderate inner curved hook; volsella region with dense, short, bristles.

Illustrations. Sting—Hazeltine & Chandler, 1964: pl. 2. Gastral sternites 7 and 8—Franklin, 1913: figs. 31, 127, 129, 134. Genitalia—Franklin, 1913: figs. 85, 86, 89, 90.

N. AMERICA.

11. *CROTCHIBOMBUS* Franklin, 1954

♀. Ocelli separated by somewhat less than two diameters from eyes, lying well in front of postocular line. Frons rather sparsely punctured in region of ocelli except for a densely punctured quadrate area immediately behind them, unpunctured areas very ill-defined, a number of very fine but not very close punctures between them and the eyes, nearer the latter. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 10 : 6 : 6\frac{1}{2}$ , segment 3 just longer than twice as long as broad. Clypeus short, rather strongly swollen, with not very close but general punctures, mostly rather small but some large, apical impressions strong, very

closely punctured. Labrum with tubercles moderately convex, laterally flattened, inner end angled, furrow deep but narrower than length of antennal segment 3, lamella curved, moderately broad. Mandibles with a feeble incisura and a rather weak sulcus obliquus. Malar space transverse (= 9), a little shorter than antennal segment 3. Mid basitarsus with posterior apical angle feebly angled. Hind tibia with corbicular surface bare, feebly reticulate, corbicular hairs not short and dense as in *B. fraternus* (Smith), inner dorsal apical angle strongly produced, hind basitarsus with short pubescence. Gaster with pubescence short but not closely appressed as in *Fraternobombus*, tergite 6 moderately shining and coarsely rugose. Sting with outer thickenings rather wide but somewhat narrow in centre, inner thickenings widening for a short distance below, but then rather suddenly narrowing again and remaining of even width to dorsal end, lower part considerably darkened, intervening membrane apparently not differentiated but a blackened convex area near the narrowing of the inner thickenings. Wings evenly infusate.

♂. Rather large, eyes large and swollen, ocelli separated by half a diameter from eyes, lying far in front of postocular line. Antennae long, segments 3 : 4 : 5 : 8 =  $8\frac{1}{2}$  :  $6\frac{1}{2}$  :  $9\frac{1}{2}$  : 9. Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space very short and transverse (= 5), shorter than antennal segment 4, not punctured. Mid basitarsus very long and narrow ( $52 \times 9$ ), posterior apical angle rounded, fringes short. Hind tibia narrow, especially at base, gently convex, shining, with sparse short hairs throughout, dorsal fringe rather sparse but nearly as long as apical width of tibia. Hind basitarsus ( $52 \times 13$ ), dorsal apical angle a rounded right angle, dorsal fringe not dense but nearly twice as long as its width. Gastral sternite 6 a little thickened but not reflexed subapically, thickening truncate in centre, a short dense subapical fringe. Gastral sternite 7 in the form of a wide, curved, transverse band, fore and hind margins nearly parallel, a large patch of short dense bristles on each side, no lines or fenestrae. Gastral sternite 8 a narrow band, strongly produced into a tongue-shaped process, sides slightly convergent, angles rounded, apex approximately straight, most of surface with dense, short bristles, two parallel lines and a small, subapical fenestra. Genitalia large, stipes rather long and broad with a wide, well-defined, inner impression. Sagitta narrow, slightly less so in side view, no ventral tooth, end hooked inwards, end of hook narrow and pointed, whole hook elongate, outer side with a slight flange which does not end anteriorly in a tooth. Spatha broad, sides very rapidly converging, at mid point three times as wide as sagitta. Squama rounded triangular, moderately large, with a small antero-internal process separated from the rest by a narrow emargination, process wide in the transversely dorso-ventral plane. Lacinia not much projecting beyond the squama, curved, parallel-sided, end emarginate, outer angle produced into a small acute point, inner angle forming a small hook, somewhat widened in dorso-ventral plane. No dense bristles on lacinia or volsellar region.

Illustrations. Sting—Hazeltine & Chandler, 1964 : pl. 2. Gastral sternites 7 and 8—Franklin, 1913 : figs. 117, 130. Genitalia—Franklin, 1913 : figs. 81, 88.

WESTERN U.S.A., MEXICO.

## 12. *SIBIRICOBOMBUS* Vogt, 1911

*Obertobombus* Reinig, 1930

♀. Ocelli separated by two diameters from eyes or rarely fully two and a half diameters, lying well in front of postocular line. Frons closely and rather finely punctured, unpunctured areas small and well-defined, a wide band of fine sculpture along inner margin of eyes. Dorsal furrow of gena sometimes weakly developed. Antennal segments 3 : 4 : 5 =  $10\frac{1}{2}$  :  $4\frac{1}{2}$  : 5, segment 3 about four times as long as broad. Clypeus elongate, strongly swollen, rather closely punctured, even more so in the well-marked apical impressions. Labrum with tubercles rather small and convex, furrow not wide, much narrower than length of antennal segment 3, lamella nearly straight. Mandibles with no incisura and a well-marked sulcus obliquus. Malar space very elongate (= 17), longer than antennal segments 2 + 3, with many fine punctures. Mid

basitarsus with posterior apical angle somewhat produced. Hind tibia with corbicular surface bare, feebly reticulate, inner dorsal apical angle rather weakly produced, hind basitarsus with short pubescence, dorsal apical angle almost spinose, auricle covered with dense short hairs. Gastral tergite 6 rather strongly granulate, usually dull. Sting with outer thickenings of the sheath narrow, rarely a little widened above, inner thickenings very little widened below, a little blackened near centre in an adjacent membranous lobe, membrane also brown and convex in a small dorsal area. Wings evenly but not strongly infusate.

♂. Eyes normally large and swollen with temples narrow, but unmodified in *B. sibiricus* (Fabricius), when enlarged ocelli lying far in front of postocular line; ocelli separated normally by one diameter from eyes, but by two and a half diameters in *B. sibiricus* (Fabricius). Antennae very long, 3 : 4 : 5 : 8 = about 9 : 5½ : 8½ : 9 or in *B. sibiricus* (Fabricius) 7 : 5 : 9½ : 9½, penultimate segments nearly straight. Mandibles with a broad ventral and a small dorsal tooth, beard pale, dense but rather short. Malar space much longer than broad (= *c.* 9), longer than antennal segments 2 + 3, with many fine punctures. Mid basitarsus very long and parallel-sided (38 × 8), posterior apical angle acute, fringes very short. Hind tibia not very elongate, strongly convex (less so in *B. sibiricus* (Fabricius)), hairy, the hairs arising from granulate punctures, dorsal fringe very long. Hind basitarsus (40 × 12) dorsal apical angle acute, dorsal fringe long. Gaster with short not very close hairs, not very closely punctured or reticulate. Gastral sternite 6 little modified but usually distinctly emarginate (not in *B. obtusus* Richards). Gastral sternite 7 rounded rectangular with apex widely straight truncate, with considerable area of fine short hairs, no lines or fenestrae. Gastral sternite 8 produced but sides of production strongly converging posteriorly, with a small truncate apex and an apical tuft of longish bristles, no fenestrae, lines absent or feebly developed at base. Genitalia elongate, rather large; stipes with a strong (in *B. sibiricus* (Fabricius) weaker) sharp-edged inner impression, half its width; sagitta narrow, dorsal half submembranous, strongly bent down at apex where hooked inwards, hook very long and pointed, no real outer flange, sagitta in side view much wider but gradually narrowing to apex, no ventral tooth or emargination; spatha fully twice as wide as sagitta, almost parallel-sided; squama rather long, outer and posterior edges forming a continuous curve, inner edge with a deep oval emargination leaving a wide, rounded, posterior, inner process and a narrow, acute, anterior one; lacinia projecting some way beyond squama, considerably narrowed and curved inwards towards apex which is truncate with inner corner forming a slight hook, apex and outer edge with dense short bristles; volsellar region with very dense, moderately long, stout bristles.

Illustrations. Sting—Text-fig. 9. Gastral sternites 7 and 8—Radoszkowski, 1884 : figs. 44c, 44d; Pittioni, 1939a : pl. 4, fig. 1. Genitalia—Pittioni, 1939a : pl. 4, fig. 1.

EASTERN EUROPE to northern ASIA and mountains of S. ASIA.

### 13. *CULLUMANOBOMBUS* Vogt, 1911

*Rufocinctobombus* Frison, 1927

♀. Ocelli separated by rather less than three or (*B. rufocinctus* Cresson) rather more than two diameters from eyes, lying well in front of postocular line. Frons closely and rather finely punctured, unpunctured areas small and well-defined, a wide band of fine punctures along inner margin of eyes. Dorsal furrow of gena sometimes developed. Antennal segments 3 : 4 : 5 = 8 : 5 : 5½ (or *B. rufocinctus* Cresson 8 : 4½ : 4½), segment 3 about twice as long as broad. Clypeus rather swollen, rather closely and evenly punctured or (*B. rufocinctus* Cresson) shining and sparsely and more coarsely punctured, apical impressions rather deep or (*rufocinctus*) small and shallow. Labrum with tubercles rather small and flattened, somewhat angled at inner end, furrow rather narrower than length of antennal segment 3, lamella short and curved. Mandibles with no incisura but with a more or less well-marked sulcus obliquus. Malar space just transverse (= 9), a little longer than antennal segment 3 or (*B. rufocinctus* Cresson) distinctly transverse and clearly shorter than segment 3. Mid basitarsus with posterior apical angle rounded. Hind tibia with corbicular surface bare, finely or (*B.*

*rufocinctus* Cresson) more strongly reticulate, inner dorsal apical angle produced but not strongly so, hind basitarsus with short, not very dense pubescence, dorsal edge strongly curved (except *B. rufocinctus* Cresson). Gastral tergite 6 dull, granulate and sparsely punctured with traces of a longitudinal furrow. Sting with outer thickenings of sheath considerably widened above, inner thickenings rather strongly widened and somewhat blackened below, two small blackened areas in membrane just above the widening, no other folds in membrane. Wings with apex darkened.

♂. Eyes scarcely or (*B. rufocinctus* Cresson) more distinctly enlarged, ocelli separated by two and a quarter diameters from eyes or (*B. rufocinctus* Cresson) rather less than two diameters, just in front or well in front of postocular line. Antennae moderately long, segments 3 : 4 : 5 : 8 = 6 : 4½ : 7½ : 7½ (in *B. rufocinctus* Cresson segment 3 nearly as long as 5), penultimate segments straight. Mandibles with a broad ventral and small dorsal tooth, beard dense but not very long. Malar space just transverse (= 5), about as long as antennal segment 3, with numerous fine punctures. Mid basitarsus moderately long and parallel-sided (= 38 × 9), posterior apical angle a rounded right angle, fringes short. Hind tibia moderately clavate, disk convex, shining, mostly bare, with small coarse, scale-like cross-striation, dorsal fringe long but not dense. Hind basitarsus (38½ × 11) with dorsal apical angle rounded but rarely acute, fringes short or (*B. rufocinctus* Cresson) dorsal fringe long. Gaster with dense, relatively short hairs. Gastral sternite 6 with its apex somewhat truncate and thickened at the angles. Gastral sternite 7 widely crescentic, apical margin rounded with scattered short, coarse bristles, apical disk with an area of close fine ones, no lines or fenestrae. Gastral sternite 8 triangularly produced, sides not at all parallel, apex somewhat pointed, with a small area of dense, short hairs, no fenestra, two parallel lines on disk. Genitalia rather long but not wide; stipes with inner impressions feebly indicated; sagittae narrow, curved down at end where hooked inwards, actual tip of hook a little pointed, no real flange, in side view equally narrow, not widening even at base, no ventral tooth; spatha narrow, hardly widened at base, at centre hardly wider than sagitta; squama transverse though not strongly so, externally more or less rounded, distal end feebly emarginate, inner side produced into a strong but not very acute posterior point and a very short anterior tubercle, inner margin generally straight-oblique; lacinia projecting far beyond squama, narrow and parallel-sided, curving a little inwards, apex pointed, obliquely truncate, a little before apex with close short bristles on both inner and outer side; volsellar region with a group of dense, long bristles.

Illustrations. Sting—Richards, 1927 : fig. 57; Hazeltine and Chandler, 1964 : pl. 2. Gastral sternites 7 and 8—Franklin, 1913 : 55, 122; Pittioni, 1939a : pl. 3, fig. 6. Genitalia—Krüger, 1920 : fig. 60; Franklin, 1913 : figs. 79, 84; Richards, 1927 : fig. 36; Pittioni, 1939a : pl. 3, fig. 6.

EUROPE, N. ASIA, N. AMERICA, northern CENTRAL AMERICA.

#### 14. *PYROBOMBUS* von Dalla Torre, 1880

*Pyrrhobombus* von Dalla Torre, 1882

*Poecilobombus* von Dalla Torre, 1882

*Pratobombus* Vogt, 1911

*Hypnorobombus* Q. Pérez, 1927

*Lapponicobombus* Q. Pérez, 1927

This large subgenus includes species which vary much more than usual in the length of the malar space; there is also some variation in the structure of the male genitalia. Nevertheless it scarcely seems practical at present to subdivide the group.

♀. Ocelli separated by nearly three diameters from eyes, lying just in front of postocular line. Frons mostly shining and rather sparsely punctured, in species such as *B. atrocinctus*



Smith with much dense, short, velvety pile, unpunctured areas large and ill-defined, no band of fine punctures along inner margin of eyes. Dorsal furrow of gena always indicated, sometimes quite strong. Antennal segments 3 : 4 : 5 about = 7 : 4 : 5½, or, *B. atrocinctus* Smith, 7½ : 6 : 6½, segment 3 hardly twice as long as broad. Clypeus typically moderately long and swollen, largely unpunctured, with characteristic deep, well-marked apical impressions containing many large punctures, in *B. atrocinctus* Smith these impressions weak and hardly punctured. Labrum with tubercles rather flattened, furrow very narrow, narrower than length of antennal segment 3, lamella usually short and strongly curved, wider and less curved in *B. impatiens* Cresson. Mandibles usually with a well-marked incisura, no sulcus obliquus. Malar space variable, from just longer than broad and a little longer than antennal segment 3, to clearly transverse and hardly as long as 3, length varying between 8 and 12 units, not punctured. Mid basitarsus with posterior apical angle rounded. Hind tibia with corbicular surface bare, shining or moderately reticulate, inner dorsal apical angle feebly or not produced (except *B. atrocinctus* Smith), hind basitarsus with short pubescence. Gastral tergite 6 shining, finely rather sparsely punctured or granulate. Sting with outer thickenings of the sheath narrow but considerably widened for a short distance dorsally, inner thickenings narrow and not much widened below, membrane undifferentiated except for two black central spots (copulation scars) in copulated specimens. Wings rather evenly but usually not much darkened.

♂. Typically rather small. Eyes not at all swollen, ocelli separated by at least three diameters from eyes, lying about on the postocular line. Antennae not very long, segments 3 : 4 : 5 : 8 = 6 : 5 : 6½ : 6½, or (*B. atrocinctus* Smith) segment 5 a little longer (7½), penultimate segments straight. Mandibles with a large ventral and small dorsal tooth, beard long and dense. Malar space variable as in the ♀, from as long as antennal segments 2 + 3 (or shorter) to as long as segments 3 + 4, usually with scattered fine punctures. Mid basitarsus long and parallel-sided (32 × 7), still longer in *B. atrocinctus* Smith (= 46 × 9), fringes short. Hind tibia moderately convex, surface moderately shining, with long hairs except on distal third where they are short, fringes long. Hind basitarsus (= 33 × 9) apical angle subacute, fringes short. Gastral sternite 6 not recurved and hardly thickened at apex, postapical fringe short and inconspicuous. Gastral sternite 7 crescentic, not at all produced, with two almost joined groups of bristles which are longer on each side, no lines or fenestrae. Gastral sternite 8 strongly produced into a subquadrate plate, sides parallel, apex feebly emarginate, angles rounded, most of surface covered with short bristles, no lines or fenestrae; in *B. atrocinctus* Smith the produced part is narrower, with its sides more converging posteriorly, the end forming a rounded point. Genitalia typically rather short, not much longer than broad (relatively larger and longer in *B. atrocinctus* Smith); stipes rather narrow with effectively no inner impressions; sagittae narrow, bent downwards apically in a rounded right-angle, hooked inwards without broad flanges, in side view somewhat wider, emarginate beneath near base, with a small tooth at the end of emargination; in *B. atrocinctus* Smith the hook is longer with its outer edge straighter; squama very small and subtriangular, mostly in a transverse dorso-ventral plane, with a distinct anterior inner process in *B. atrocinctus* Smith. Lacinia typically very small and entirely hidden by the squama but much longer and projecting well beyond it in *B. atrocinctus* Smith, parallel-sided, apex slightly emarginate or with a strong, curved, inner hook in *B. atrocinctus* Smith; volsellar region normally almost bare but with long dense bristles in *B. atrocinctus* Smith.

Illustrations. Sting—Franklin, 1913 : fig. 172 ; Richards, 1927 : fig. 58 ; Hazeltine & Chandler, 1964 : pl. 4. Gastral sternites 7 and 8—Radoszkowski, 1884 : fig. 2c ; Franklin, 1913 : figs. 105, 125, 131, 133, 137, 140, 142, 144, 145 ; Frison, 1925 : pl. 1, figs. 2, 3 ; Frison, 1934 : figs. 5c, d, 6c, d ; Pittioni, 1939a : pl. 3, fig. 4. Genitalia—Radoszkowsky, 1884 : figs. 2a, b ; Franklin, 1913 : figs. 64, 65, 67, 190 ; Frison, 1925 : pl. 1, fig. 1 ; Richards, 1927 : fig. 37 ; Frison, 1934 : figs. 5a, 6a ; Krüger, 1920 : pl. 6, fig. p ; Pittioni, 1939a : pl. 3, fig. 4.

EUROPE, ASIA (including Burma and "Indo-China" and East Indies), N. AMERICA, C. AMERICA.

15. *MELANOBOMBUS* von Dalla Torre, 1880

*Lapidariobombus* Vogt, 1911

*Kozlovibombus* Skorikov, 1922

*Tanguticobombus* Pittioni, 1939b

This is another large and varied subgenus. The tip of the gaster almost always has red hairs (except most specimens of *B. flavothoracicus* Bingham). The malar space is normally a little longer than broad but markedly so in *B. simillimus* Smith of which the male is unknown. The labrum and other characters of *B. tanguticus* Morawitz are somewhat abnormal but there seems no reason to place it in a separate subgenus, at least until the male is known. *B. rufofasciatus* Smith and its allies have the eyes more or less enlarged with the ocelli approximated to them and the inner side of the squama more strongly emarginate than usual; nevertheless it does not seem that the group is well enough marked to be treated as a distinct subgenus.

♀. Ocelli normally separated by nearly three diameters from eye and lying just in front of postocular line but in some species separated by not much more than two diameters and lying well in front of postocular line. Frons with some large and many fine punctures, unpunctured areas rather small and well-defined (larger and ill-defined in *B. tanguticus* Morawitz), a well-marked wide band of fine punctures along inner margin of eye, this band almost ceasing behind the level of the mid-point of the ocelli in *B. rufofasciatus* etc. Dorsal furrow of gena usually more or less indicated, absent only in *B. incertus* Morawitz. Antennal segments 3 : 4 : 5 = 8 : 5½ : 6, segment 3 twice as long as broad. Clypeus long (shorter in *B. tanguticus*), rather flattened (more convex in *B. rufofasciatus*), rather finely punctured (more punctured in *B. tanguticus* and *B. rufofasciatus*, and in the first-named the punctures coarser), apical impressions feeble and not strongly punctured except in *B. tanguticus*. Labrum with tubercles not much flattened and rather dull, more angular inwardly in *B. tanguticus*, furrow broad, wider than length of antennal segment 5, or deep and narrower and hardly as wide as antennal segments in *B. tanguticus*, lamella moderately wide, little curved. Mandibles typically with no incisura and a well-marked sulcus obliquus weak or absent in *B. tanguticus*, *B. rufofasciatus* and *B. heriensis tenellus* Friese. Malar space a little longer than broad (= 10), a little longer than antennal segment 3, but somewhat longer in *B. rufofasciatus* (as long as antennal segments 2 + 3), or considerably more elongate in *B. simillimus* and *B. flavofasciatus* Bingham. Mid basitarsus with posterior apical angle rounded or in *B. tanguticus* distinctly angled. Hind tibia with corbicular surface usually bare exceptionally with some short hairs (*B. simillimus*, *B. tanguticus*), finely reticulate inner dorsal apical angle not at all or very little produced. Hind basitarsus with short pubescence, on surface usually dense except in *B. tanguticus*. Gastral tergite 6 with a raised, more or less rounded, sometimes furrowed, largely bare boss, apex in *B. rufofasciatus* somewhat truncate and emarginate, or in *B. tanguticus* distinctly emarginate. Sting with outer thickenings of the sheath narrow except at extreme dorsal end, inner thickenings narrow, a little widened on lower third and then narrowed again, not blackened except rather extensively in *B. simillimus*, or in *B. tanguticus* with whole inner thickenings wider and margin medially quite widely reflexed and dorsally shortly blackened, intervening membrane very little blackened laterally or more extensively so in *B. simillimus*. Wings typically not at all darkened, even at the tip, but dark throughout in *B. simillimus*.

♂. Typically a good deal smaller than ♀. Eyes not enlarged and ocelli separated by three diameters from eyes and lying just in front of postocular line or (*B. rufofasciatus*, etc.) eyes more or less distinctly swollen (most in *B. oculatus* Frison) ocelli separated by about two diameters or less from eyes and lying more or less strongly in front of postocular line. Antennae moderately long, segments 3 : 4 : 5 : 8 = about 7 : 4 : 6 : 5½, penultimate segments straight.

Mandibles with a large ventral and small dorsal tooth, beard long and dense. Malar space about quadrate (= 7), not quite as long as antennal segments 2 + 3, with some fine, scattered punctures. Mid basitarsus rather long, a little convergent at each end ( $40 \times 9$ , or *B. rufofasciatus*  $51 \times 11$ ), with long hairs on proximal half of dorsal edge and some on disk. Hind tibia distinctly convex, dull and reticulate, most of surface with rather sparse, moderately long hairs but a considerable bare disk on apical half (absent in *B. rufofasciatus*) fringes very long. Hind basitarsus (=  $41 \times 11$  or *B. rufofasciatus*  $50 \times 13$ ), apical angle a rounded right angle or *B. rufofasciatus*, subacute, dorsal margin with some long hairs. Gastral sternite 6 a little produced, thickened and recurved on central half and here a little emarginate. Gastral sternite 7 crescentic with centre of hind margin truncate or emarginate (rather more produced in *B. rufofasciatus*) with a large transverse patch of short bristles, no lines or fenestrae. Gastral sternite 8 not much produced posteriorly, broadly subtriangular, somewhat truncate or emarginate at apex, angles of truncation rounded, two small patches of bristles on each side, a few of the bristles long, no fenestrae but one central line. Genitalia relatively long and narrow; stipes narrow with no or with weak inner impressions; sagittae narrow in both dorsal and lateral views, no tooth or emargination beneath, end bent downwards and hooked inwards, but the hook angular and pointed like a half arrowhead; spatha long and narrow, sides feebly converging, in centre twice as wide as sagitta; squama small, not quite quadrate, rounded-transverse, with small rounded proximal inner projection, or (*B. rufofasciatus*) squama smaller with posterior vertically truncate and smaller broadly triangular proximal inner lobes; lacinia long, projecting some way beyond squama, curved, parallel-sided, and truncate or emarginate so that there are two weak angles, in *B. rufofasciatus* the inner one forming a curved hook; volsellar region with no conspicuous bristles.

Illustrations. Sting—Richards, 1927: fig. 36 [figure on pl. 6 of Hazeltine & Chandler, 1964 seems to be some wrongly determined species]. Gastral sternites 7 and 8—Pittioni, 1939a: pl. 3, fig. 3; Frison, 1933: figs. 3c, f; Frison, 1934: figs. 4e, d. Genitalia—Krüger, 1920: pl. 6, fig. n; Richards, 1927: fig. 35; Frison, 1933: fig. 3c; Frison, 1934: fig. 4a.

## EURASIA.

### 16. *PRESSIBOMBUS* Frison, 1935

♀. Ocelli separated by nearly three diameters from eyes, lying just in front of postocular line. Frons not very closely or coarsely punctured, part behind ocelli at sides with very close fine punctures, temples also with very close, fine punctures, unpunctured areas ill-defined and not large, no band of fine sculpture along inner margin of eyes, much of head with dense, feathery hairs. Dorsal furrow of gena very weak. Antennal segments 3 : 4 : 5 =  $8\frac{1}{2}$  : 5 :  $6\frac{1}{2}$ , segment 3 about two and a half times as long as broad. Clypeus moderately elongate, little swollen, with fairly numerous scattered punctures, mostly small but a few large, apical impressions well-defined with a few large punctures. Labrum with tubercles angularly raised towards inner end where they fall sharply on lower half (less so near clypeus), surface shining with large shallow punctures, furrow rather wide and shallow, at least as wide as length of antennal segment 3, lamella very inconspicuous, rather short, feebly curved. Mandibles with a feeble incisura and no sulcus obliquus. Malar space about quadrate (= 13), about as long as antennal segments 2 + 3, not punctured. Mid basitarsus with posterior apical angle obtuse. Hind tibia with corbicular surface bare, rather weakly reticulate, inner dorsal apical angle moderately produced. Hind basitarsus densely pubescent, lower edge for its whole length and part of adjacent disk with long bristles. Gastral tergite 6 slight truncate, with raised boss. Sting with outer thickenings of the sheath not wide, but wider above than below, inner thickenings wide, widest just above the middle, edge forming a smooth curve, considerably blackened, especially near middle, membrane darkened at extreme dorsal end, otherwise undifferentiated. Wings moderately, evenly, infuscate.

♂. Relatively small. Eyes not swollen, temples wide with dense feathered pubescence, ocelli separated by three diameters from eyes, lying on postocular line. Antennae moderately

long, segments  $3 : 4 : 5 : 8 = 7 : 4 : 5\frac{1}{2} : 6$ , penultimate segments straight. Mandibles with large ventral and small dorsal apical teeth, beard long, dense, pale. Malar space elongate ( $= 9\frac{1}{2}$ ), as long as antennal segments  $2 + 3$ , not punctured. Mid basitarsus ( $35 \times 6\frac{1}{2}$ ) long, narrow, parallel-sided, posterior apical angle a rounded right angle, a few long bristles in dorsal fringe. Hind tibia feebly convex, strongly shining, disk bare, fringes very long but rather sparse. Hind basitarsus ( $= 37 \times 10$ ), rather long and narrowed to base, dorsal apical angle subacute, dorsal fringe long but sparse. Gastral sternite 6 with apex a little recurved and truncate. Gastral sternite 7 unusually strongly produced, apex feebly curved, a large patch of short, black-based bristles and a group of long feathered hairs on each side, no lines or fenestra; gastral sternite 8 considerably produced, sides nearly parallel but somewhat converging posteriorly, apex truncate, angles quite well-marked, a large patch of short bristles, two parallel lines joining at centre and proceeding backwards as one, between them a transparent area, almost forming a fenestra. Genitalia relatively large; stipes with a broad, sharp-edged inner impression; sagitta in dorsal view wide at base, narrow after middle, apex moderately bent down, feebly hooked inwards with a small, sharp flange, externally with a much larger acute flange, in side view wide at base then somewhat emarginate, then widened again and then narrowing to apex though still relatively wide, no ventral tooth; spatha wide, little narrowed posteriorly, nearly twice as wide as sagitta, acutely produced between basal inner processes of stipes; squama very unusual in that it is completely fused to the stipes, represented by a long, narrow, acute process, directed obliquely backwards and inwards; lacinia rather elongate, twisted so that in dorsal view it appears very narrow, apically, from side apex is obliquely truncate with dense rather short bristles at tip and along whole inner edge; volsellar region with short moderately dense hairs.

Illustrations. Sting—Text-fig. 10. Gastral tergites 7 and 8—Frison, 1935: figs. 1e, f. Genitalia—Frison, 1935: fig. 1b.

## HIMALAYAS.

### 17. *RUFIPEDIBOMBUS* Skorikov, 1922

Very large species. ♀. Ocelli separated by three diameters from eyes somewhat in front of postocular line. Frons not much punctured, punctures fine, particularly in front of and at sides of ocelli, unpunctured area large and ill-defined, some fine punctures along inner margin of eyes, much of head with dense velvety hairs as well as bristles. Dorsal furrow of gena more or less developed. Antennal segments  $3 : 4 : 5 = 11 : 8 : 9$ , segment 3 not three times but more than twice as long as broad. Clypeus moderately long, swollen, irregularly and not very closely or coarsely punctured, apical impressions deep but not closely punctured. Labrum with tubercle strongly angled at inner end, furrow moderately distinct, about as wide as length of antennal segment 3, lamella wide, little curved. Mandibles with a weak or no incisura, no sulcus obliquus. Malar space distinctly longer than broad ( $= 16$ ), nearly as long as antennal segments  $4 + 5$ , feebly punctured ventrally. Mid basitarsus with apical dorsal corner not angled. Hind tibia with corbicular surface not reticulate, typically with sparse, short feathered hairs, dorsal corbicular fringe very dense, dorsal inner apical angle acutely produced. Hind basitarsus not densely pubescent. Gastral tergite 6 variable, finely or coarsely granulate, apical half keeled, swollen or hollowed out. Sting with outer thickenings of the sheath very narrow, more or less distinctly widened above, inner thickenings considerably widened below to just above the middle then narrowed again, edge considerably blackened, just inside this on each side a very strong, shining, convex fold of the membrane. Wings evenly yellowish or infusate, or darker at tip.

♂. Large but much smaller than ♀. Eyes not swollen, ocelli separated by two and a half diameters from eyes, just in front of postocular line. Antennae very long, segments  $3 : 4 : 5 : 8 = 7\frac{1}{2} : 6\frac{1}{2} : 10 : 10$ , penultimate segments straight. Mandibles with a broad ventral and a small dorsal tooth, beard long and dense. Malar space distinctly longer than broad ( $= 12$ ), a little longer than  $2 + 3$  but shorter than  $3 + 4$ , almost unpunctured. Mid basitarsus ( $=$

48 × 11), long and parallel-sided, posterior apical angle rounded, posterior fringe nearly as long as its width. Hind tibia not very clavate, flat, shining, with numerous, quite long, feathered hairs, fringes long and dense, especially the dorsal one. Hind basitarsus (= 54 × 14) parallel-sided, relatively broad, posterior dorsal angle a rounded right-angle, fringes short. Gaster with dense, moderately short hairs, tergites closely and rather strongly punctured and strongly reticulate. Gastral sternite 6 smooth and shining, central third produced into rounded lobe which is a little thickened and reflexed. Gastral sternite 7 widely crescentic, apex shallowly curved, with two small groups of short bristles, no lines or fenestrae. Gastral sternite 8 very transverse, little produced and produced part wide, feebly emarginate at apex, a small apical group of bristles, disk with a bi-emarginate thickening. Genitalia with inner impressions of stipes large but ill-defined, inner side with a large, pale membranous band, sagitta in dorsal view relatively narrow, dorsal half pale and submembranous, lower half darker sclerotised, apex bent down and hooked inwards, hook not very long but moderately sharp with a wide outer flange on the bend, in side view it is very wide at base but narrows regularly towards the apex, with no ventral tooth or emargination, except a slight projection at the base of the flange; spatha almost quite parallel-sided, a little wider than sagitta; squama small, almost entirely developed on the inner side of stipes in an S-like curve with its inner end forming a small backwardly directed hook; lacinia projecting far beyond the squama, broad at base with a central membranous area, narrowing to apex which is roundly pointed but sometimes irregular, almost bare, tips of lacinia tending to curve inwards and almost meeting; volsellar region entirely without bristles.

Illustrations. Sting—Text-fig. 11. Gastral sternites 7 and 8—Frison, 1930 : figs. 6, 7 ; Frison, 1934 : figs. 3c, d. Genitalia—Frison, 1930 : fig. 5 ; Frison, 1934 : fig. 3a.

S.W. CHINA, HIMALAYAS, FORMOSA [TAIWAN], EAST INDIES.

*Bombus festivus* Smith, of which the male and worker have been unknown, seems now almost certainly to belong to *Pyrobombus* (= *B. atrocinctus* Smith) von Dalla Torre.

## 18. *ALPINOBOMBUS* Skorikov, 1914

Large species. ♀. Ocelli separated by three diameters from eyes, lying just in front of or on the postocular line. Frons rather feebly punctured, especially behind the level of the ocelli laterally, unpunctured areas ill-defined, a rather broad band of very fine sculpture along inner margin of eyes. Dorsal furrow of gena distinct. Antennal segments 3 : 4 : 5 = 9 : 6 : 7 or 8 : 5 : 6, segment 3 twice as long as broad or slightly less. Clypeus moderately long and swollen, generally but not very coarsely punctured, apical impressions rather strong, strongly and closely or rather closely punctured. Labrum with tubercles flattened, not much angled at inner ends, furrow narrow, narrower than length of antennal segment 3, lamella short, curved, inconspicuous. Mandibles with no incisura and a weak sulcus obliquus. Malar space longer than broad, longest in *B. hyperboreus* Schönherr (= 16), as long as antennal segments 3 + 4, shortest in *B. arcticus* Kirby (= 12), as long as antennal segments 2 + 3. Mid basitarsus with apical dorsal angle a rounded right angle. Hind tibia with corbicular surface bare, hardly reticulate, dorsal inner apical angle shortly and broadly produced. Hind basitarsus not densely pubescent. Gastral tergite 6 moderately shining, granulate, sometimes coarsely. Sting with outer thickenings moderately wide, especially above, inner thickenings greatly widened below, with two isolated blackened spots (sometimes fused), in the membrane between them. Wings if somewhat infusate, evenly so.

♂. Relatively large. Eyes not swollen, ocelli separated by three diameters from eyes, lying on postocular line. Antennae moderately long, segments 3 : 4 : 5 : 8 = 6½ : 4½ : 8 : 8, penultimate segments straight. Mandibles with one broad ventral and one small dorsal tooth, beard long and dense. Malar space (= *c.* 9) about quadrate, a little longer than 2 + 3 but shorter than 3 + 4, with scattered fine punctures. Mid basitarsus (= 38 × 11) moderately long, rather broad, somewhat narrowed at base, posterior apical angle a rounded right angle,

a few long hairs in posterior fringe. Hind tibia rather clavate, with large, bare, convex disk, both fringes very long. Hind basitarsus ( $= 42 \times 13$ ), moderately long, rather broad, posterior apical angle a rounded right angle, dorsal fringe very long. Hairs of gaster long and shaggy. Gastral tergite 6 with apical margin strongly thickened and somewhat recurved, centre feebly truncate, postapical fringe weak. Gastral sternite 7 rather narrowly crescentic with two separate groups of long bristles, no lines or fenestrae. Gastral sternite 8 produced into a tongue-like process, sides very converging posteriorly, almost pointed, a small posterior area of short bristles, no fenestrae, sometimes two weak parallel lines on disk. Genitalia relatively elongate; stipes with no inner impressions; sagitta in dorsal view rather narrow and sinuate, apex not bent down, with a preapical flange forming a small tooth, at apex slightly hooked on both sides, in side view narrow at base then considerably widened with a large central tooth, a smaller tooth beneath the flange, all these details varying somewhat specifically; spatha wide, sides strongly converging, at centre three times as wide as sagitta; squama large, longer than broad, inner and outer sides parallel and the whole structure somewhat bent inwards, the inner edge at a lower level feebly serrate, a slight emargination forming a very small process next the end of the stipes, details of squama varying specifically; lacinia very long, projecting some way beyond the squama, narrowed but a little before the apex widened again, apex slightly emarginate, inner corner produced inwards into a feeble, rounded, serrate lobe; bristles on volsellar area dense but not long.

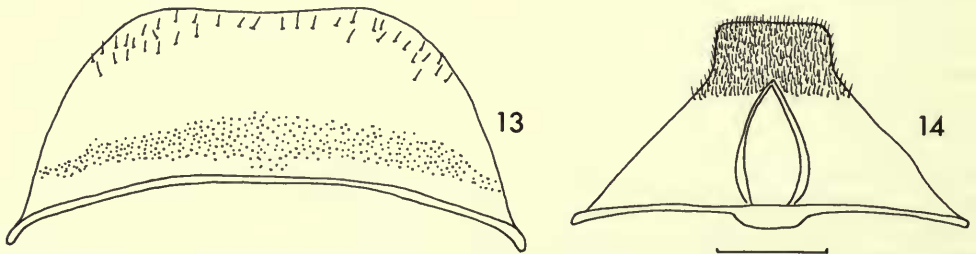
Illustrations. Sting—Franklin, 1913: fig. 173; Hazeltine & Chandler, 1964: pl. 5. Gastral sternites 7 and 8—Franklin, 1913: figs. 115, 123, 165; Richards, 1931: pl. 1; Pittioni, 1939a: pl. 3, fig. 3. Genitalia—Franklin, 1913: fig. 173; Pittioni, 1939a: pl. 3, fig. 3.

ALPS, ARCTIC EURASIA and AMERICA, Rocky Mts., Californian Sierras.

### 19. *ROBUSTOBOMBUS* Skorikov, 1922

*Volucellobombus* Skorikov, 1922

♀. Ocelli separated by two diameters or rather less from eyes, lying well in front of postocular line. Frons with large areas both in front and behind the level of the ocelli without punctures, unpunctured areas very large and ill-defined, no band of fine sculpture along inner margin of eyes. Dorsal furrow of genera absent. Antennal segments  $3 : 4 : 5 = 10 : 5\frac{1}{2} : 6\frac{1}{2}$ , segment 3 rather more than twice as long as broad. Clypeus rather short, strongly swollen, with few or only a moderate number of punctures, apical impressions feeble, with a few large punctures or with numerous small ones in addition. Labrum with tubercles moderately convex and angled at inner end, furrow very wide, about as wide as length of antennal segment 3, lamella not wide, curved. Mandibles with a feeble incisura and a strong sulcus obliquus. Malar space ( $= 10$ ) distinctly transverse, shorter than or no longer than antennal segment 3. Mid basitarsus with the apical dorsal angle hardly less than a right angle. Hind tibia with corbicular surface dull, densely reticulate (though much more finely than in *Mendacibombus*), proximal third of surface with long bristles, dorsal inner apical corner with a short but acute process. Hind basitarsus not densely pubescent but whole surface and margins with much



FIGS. 13-14. *Bombus robustus* Smith. 13, gastral sternite 7; 14, gastral sternite 8.

coarser bristles than usual. Gastral tergite 6 shining, finely granulate. Sting with outer thickenings of the sheath moderately broad and of even width, inner thickenings considerably widened below, the wide part ending in an emargination defined by two blackened and somewhat projecting points, the emargination sometimes bounded externally by a small blackened line, intervening membrane undifferentiated or raised dorsally into a horseshoe-like fold, a little blackened at each end. Wings infusate.

♂. Relatively small. Eyes rather swollen, temples rather narrow dorsally, ocelli separated by a little less than one diameter from eyes, far in front of postocular line. Antennae long, segments  $3 : 4 : 5 : 8 = 7\frac{1}{2} : 5 : 8 : 7$ , penultimate segments straight. Mandibles with one wide ventral and one small dorsal tooth, beard dense, moderately long. Malar space (= 4) transverse, about as long as antennal segment 4, scarcely punctured. Mid basitarsus (=  $42 \times 8$ ) very long and narrow, somewhat narrowed at each end, posterior apical angle completely rounded, dorsal margin with very long bristles and a few also on the disk. Hind tibia moderately clavate, convex, a little dull and reticulate, with moderately long hairs throughout, fringes long, especially the dorsal one. Hind basitarsus ( $43 \times 11$ ) moderately long and broad, somewhat narrowed basally, posterior apical angle a rounded right angle, posterior margin with numerous long bristles. Pubescence of gaster long and shaggy. Gastral sternite 6 with margin rounded, scarcely thickened, with a dense, pale postapical fringe. Gastral sternite 7 widely crescentic, apical margin somewhat truncate, almost no bristles, no lines or fenestrae. Gastral sternite 8 with a tongue-like projection with its sides converging and only becoming parallel near the apex which is straight, angles rounded, a large apical patch of short dense bristles, no fenestra, two lines which converge close to one another posteriorly. Genitalia moderately large and elongate; stipes not curved in at apex, with wide, deep, inner impressions; sagitta in dorsal view narrow, bent downwards and hooked inwards at apex, tip of hook with a long, relatively narrow point, outer side with a moderately long and broad, weakly serrate flange, in side view with sagitta is only about twice as wide, not widened at base and without a tooth; spatha rather narrow, sides not much converging, about one and a half times as wide in centre as sagitta; squama very transverse but considerably widened inwards, outer edge with a considerable rounded-angular projection, considerably narrowed to the actual apex and here with a small bristle tuft and a little emarginate with the inner corner produced into a long, curved hook; volsella area with short not very dense bristles.

Illustrations. Sting—Text-fig. 12. Gastral sternites 7 and 8—Text-figs. 13, 14. Genitalia—Franklin, 1913 : figs. 181, 197.

Southern C. and S. AMERICA.

## 20. *RUBICUNDOBOMBUS* Skorikov, 1922

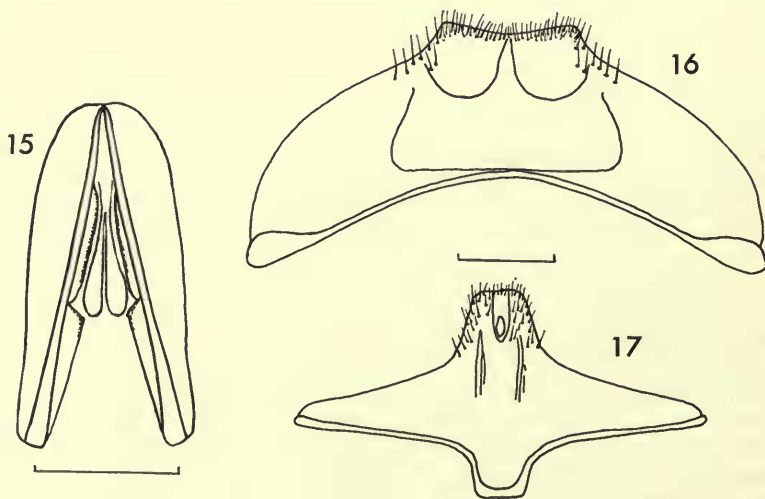
♀. Ocelli separated by three diameters from eyes, lying a little in front of postocular line. Frons rather closely punctured, unpunctured areas large but not well-defined, a well-marked band of fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 8 : 4 : 6\frac{1}{2}$ , segment 3 slightly more than twice as long as broad. Clypeus rather short, basal half much swollen, ventral third flattened, whole with numerous punctures, mostly large, apical impressions not defined, with close, rather small punctures. Labrum with tubercles convex, rather strongly angled at inner end, furrow very narrow, much narrower than the length of antennal segment 3, lamella not wide, moderately curved. Mandibles with a feeble incisura and a strong sulcus obliquus. Malar space (= 8) short and transverse, as long as antennal segment 3, without any punctures. Mid basitarsus with apical dorsal angle almost rounded. Hind tibia with corbicular surface rather dull, finely reticulate, proximal two fifths with rather sparse bristles on disk, dorsal inner apical corner distinctly produced. Hind basitarsus not densely pubescent but for the bristles on the dorsal edge. Gastral tergite 6 dull, finely reticulate, finely and sparsely punctured. Sting with outer thickenings of the sheath very wide, inner thickenings gradually widening upwards from below but soon ending in a right-angled truncation, above this widening again in a smooth curve, margins somewhat

blackened, intervening membrane forming on each side a somewhat pyriform, convex, deep brown lobe. Wings dark.

♂. Of moderate size. Eyes hardly enlarged, ocelli separated by one and a half diameters from eyes lying far in front of postocular line. Antennae not long, segments  $3 : 4 : 5 : 8 = 6 : 4 : 6\frac{1}{2} : 5\frac{1}{2}$ , penultimate segments straight. Mandibles with one broad ventral and a narrow dorsal tooth, beard long and dense. Malar space transverse ( $= 5$ ), about as long as antennal segment 3, unpunctured. Mid basitarsus ( $= 39 \times 8\frac{1}{2}$ ) long, nearly parallel-sided, posterior apical angle a rounded right-angle, posterior fringe long. Hind tibia rather clavate, convex and with numerous rather long bristles on basal two thirds, apical third bare, weakly reticulate, dorsal fringe very long, ventral one much shorter. Hind basitarsus ( $= 38 \times 13$ ) relatively short and broad, somewhat narrowed to base, dorsal margin somewhat curved, with a very long fringe, posterior apical angle rounded. Hairs of gaster dense and rather uneven, tergites closely, rather coarsely punctured and reticulate. Gastral sternite 6 somewhat produced, especially over central quarter which is truncate and feebly emarginate, with a small depression embracing the truncation and extending a short way forwards. Gastral tergite 7 transverse with the central quarter moderately produced, shallowly emarginate, corners angled, with two dense tufts of bristles, disk with two suboval fenestrae, on each side of produced part with a semioval marginal reticulate area. Gastral sternite 8 subtriangular, the produced part with strongly converging sides, apex shallowly emarginate, with dense short bristles, disk with two parallel lines. Genitalia elongate, rather large; stipes with a deep, sharp-edged inner impression over two-thirds its width; sagitta in dorsal view narrow, not much bent down at tip, apex acutely pointed, behind this on inner side a small flange leading some way to a small inner dorsal tooth, in side view sagitta much wider, gradually narrowing to apex, no ventral emargination or tooth; spatha rather narrow, about one and a half times as wide as sagitta, sides sub-parallel; squama quite large, externally rounded, inner side with a large, deep, almost circular emargination, producing internally a wide posterior and a much narrower, pointed anterior process; lacinia not projecting beyond squama, rather wide, apex truncate, with a dense tuft of relatively long bristles, inner end forming a small hook; volsellar area with dense, short bristles.

Illustrations. Sting—Text-fig. 15. Gastral sternites 7 and 8—Text-figs. 16, 17; Franklin 1913: fig. 152. Genitalia—Franklin, 1913: figs. 186, 195.

#### S. AMERICA.

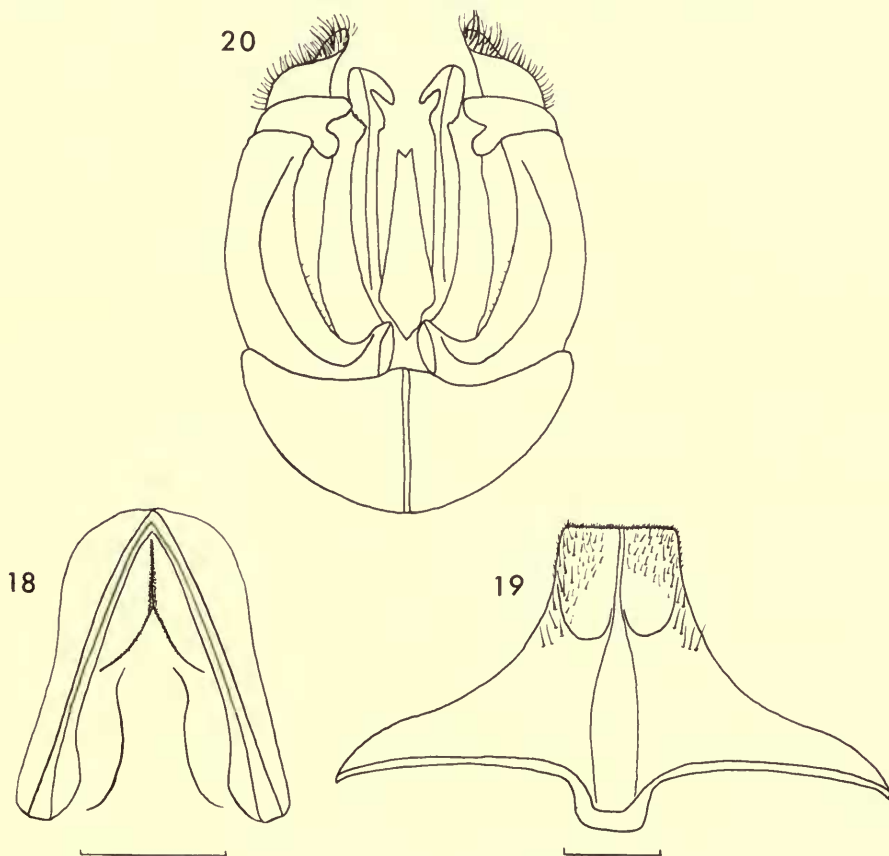


FIGS. 15-17. *Bombus rubicundus* Smith. 15, sting; 16, gastral sternite 7; 17, gastral sternite 8.



21. *COCCINEOBOMBUS* Skorikov, 1922

♀. Ocelli separated by two and a half diameters from eyes, lying entirely in front of post-ocular line. Frons with rather numerous, not very large punctures, unpunctured areas moderately large and well-defined but with a wide transverse band of fine punctures across the middle, another band of fine and a few large punctures along inner margin of eye, temples with a wide unpunctured band next to eyes. Dorsal furrow of gena absent. Antennae with segments  $3 : 4 : 5 = 10\frac{1}{2} : 6\frac{1}{2} : 7$ , segment 3 just over twice as long as broad. Clypeus a little broader than long, not much swollen, with moderately numerous, mostly large punctures over whole surface, apical impressions fairly distinct, large, with numerous punctures, some large. Labrum with tubercles large, strongly punctured but not angular, furrow wide and rather shallow, not quite as wide as length of antennal segment 3, ill-defined, lamella much wider than furrow, feebly curved. Mandibles with no incisura or sulcus obliquus. Malar space just transverse ( $= 17$ ), about as long as antennal segments  $2 + 3$ . Mid basitarsus with posterior apical angle about a right angle. Hind tibia with surface dull, finely reticulate, whole surface with scattered but quite numerous short, non-feathered hairs, corbicle moderately dense, inner dorsal apical angle long, acute. Hind basitarsus with apical dorsal angle just acute, no bristles on margins longer than half its width, surface with dense, feathered, black pubescence. Gastral tergite 6 dull, granulate, apical quarter with a raised boss (almost as in *Melanobombus*) but divided by a deep, well-defined furrow. Sting with outer thickenings of sheath wide dorsally and



FIGS. 18-20. *Bombus coccineus* Friese. 18, sting; 19, gastral sternite 8; 20, ♂ genitalia.

narrow ventrally, inner thickenings moderately widened on ventral quarter, above this narrow, not darkened, intervening membrane dark, rather convex dorsally. Wings subhyaline.

♂. Relatively small and narrow; eyes not swollen, ocelli separated by two diameters from eyes, lying distinctly in front of postocular line. Antennae moderately long, segments  $3 : 4 : 5 : 8 = 7\frac{1}{2} : 4 : 6\frac{1}{2} : 7\frac{1}{2}$ , penultimate segments not curved. Mandibles with broad ventral and small dorsal tooth, beard long and dense. Malar space about quadrate (= 9), not quite as long as antennal segments 2 + 3, unpunctured. Mid basitarsus (=  $47 \times 12$ ) long, narrow, somewhat narrowed at each end, posterior apical angle quite rounded off, posterior fringe long but diffuse. Hind tibia moderately widened, surface shining but alutaceous, with sparse short hairs, fringes, especially dorsal one, long and dense. Hind basitarsus (=  $47 \times 13$ ) moderately long and broad, somewhat narrowed at base, posterior apical angle a rounded right angle, dorsal edge with a long, rather dense fringe. Hairs of gaster rather shaggy. Gastral sternite 6 a little recurved and thickened at apex with a dense apical fringe. Gastral sternite 7 transverse, apex widely emarginate with a small tooth in centre of emargination, two large reticulate areas on each side, just connected along posterior margin, two small lateral areas of short bristles, no fenestrae. Gastral sternite 8 produced in a long, rather narrow, mostly parallel-sided tongue, apex truncate, a large apical area of short dense bristles, two parallel lines on disk. Genitalia rather short and broad, dull; stipes wide with a deep wide inner impression, basal inner process strong, almost parallel-sided; sagitta in dorsal view narrow, ventral half much more sclerotised than dorsal half, apex bent downwards and hooked inwards, hook pointed, inner edge straight (almost a half arrow head) outer side with a narrow, very finely serrate edge, sagitta in lateral view twice as wide; no ventral tooth or emargination; spatha about two and a half times as wide in centre as sagitta, sides rather converging; squama short and very transverse, angles rounded, projecting inwards beyond the stipes, a second rather thickened inner lobe separated from the posterior one by a narrow emargination; lacinia projecting a short distance beyond squama, generally curved and parallel-sided, a bit narrowed at apex but twisting inwards and upwards, actual tip narrow and rounded truncate, both inner and outer surfaces with dense short pubescence; volsellar region with short, not very dense pubescence.

Illustrations. Sting—Text-fig. 18. Gastral sternites 7 and 8—Text-fig. 19; Franklin, 1913: fig. 155. Genitalia—Fig. 20; Franklin, 1913: figs. 185, 191, 192.

Western S. AMERICA.

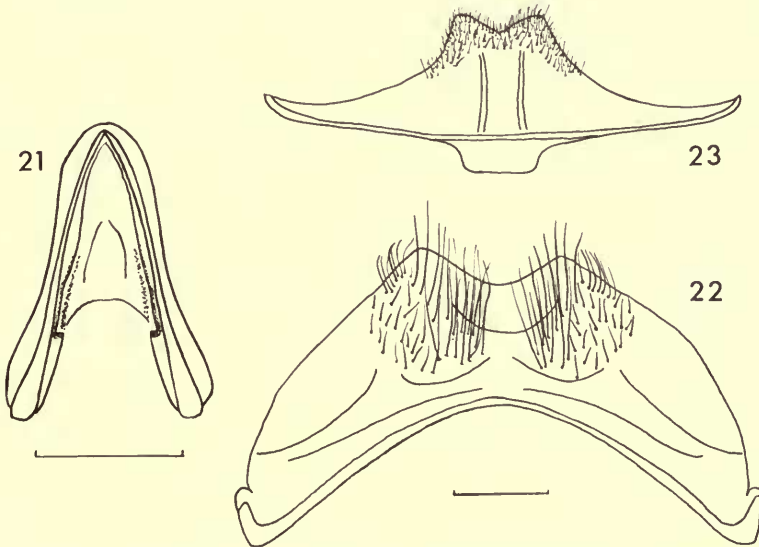
## 22. *FUNEBRIBOMBUS* Skorikov, 1922

♀. Ocelli separated by two and a half diameters from eyes, lying rather distinctly in front of postocular line. Frons quite closely punctured, unpunctured areas large but well-defined, a wide band of fine punctures along inner margins of eyes. Dorsal furrow of gena absent. Antennae with segments  $3 : 4 : 5 = 9 : 5 : 6$ , segment 3 nearly two and a half times as long as broad. Clypeus short, swollen, with numerous punctures mostly large, apical impressions moderately distinct, with close large or moderately large punctures. Labrum with tubercles convex, angled at inner end, furrow narrow, clearly narrower than length of antennal segment 3, lamella little curved, moderately wide. Mandibles with no incisura, ventral corner produced into a short, acute process, sulcus obliquus moderately strong. Malar space moderately transverse (= 9), about as long as antennal segment 3. Mid basitarsus with apical dorsal angle almost rounded. Hind tibia with corbicular surface bare, feebly reticulate, inner dorsal apical angle almost spinosely produced. Hind basitarsus with apical dorsal angle just less than a right angle, surface unusually bare and shining, bristles nowhere dense or long. Gastral tergite 6 shining, on posterior half dull, reticulate and finely and rather closely punctured with traces of a feeble longitudinal furrow. Sting with outer thickenings of sheath moderately broad, inner thickenings gradually but not very strongly widened below, ending above in rounded blackened knob, above this slightly widened again and sending down an ill-defined process towards the knob, lower part dark and margin blackened, upper process slightly blackened, intervening membrane little differentiated. Wings evenly but not greatly infusate.

♂. Relatively small; eyes a little swollen though temples are quite broad, ocelli separated by rather less than two diameters from eyes, lying well in front of postocular line. Antennae long, segments  $3 : 4 : 5 : 8 = 8 : 5 : 7 : 7\frac{1}{2}$ , penultimate segments hardly curved. Mandibles with a broad ventral and a small dorsal tooth, beard long and dense. Malar space just transverse (= 6), a little longer than antennal segment 4 but shorter than 5, with scattered fine punctures. Mid basitarsus (=  $40 \times 10$ ) moderately long and parallel-sided, posterior apical angle a rounded angle, posterior fringe long. Hind tibia clavate, convex, finely reticulate, a little shining, hairy throughout, hairs moderately long and not dense, dorsal fringe long and moderately dense, ventral fringe shorter and denser. Hind basitarsus (=  $37 \times 11$ ) somewhat narrowed at base, posterior apical angle acute but not very sharp, dorsal fringe and some discal hairs near it very long, at least twice as long as width of tarsus. Hairs of gaster, long, shaggy, not very dense. Gastral sternite 6 hardly thickened or reflexed at apex, slightly truncate. Gastral sternite 7 widely crescentic, apex weakly emarginate, with a preapical submembranous area and two patches of long bristles before apex, no lines (except some transverse ones) or fenestrae. Gastral sternite 8 widely produced, sides of produced part concave and considerably diverging anteriorly, apex a little emarginate, an apical patch of dense, short bristles, spreading sparsely down each side, two widely separated feebly curved lines, almost parallel. Genitalia relatively long and large; impressions of stipes small and ill-defined; sagittae in dorsal view narrow, curved down at apex almost at apex, curving outwards, then inwards but apex scarcely hooked, a distinct serrate preapical outer flange, in lateral view sagitta about twice as wide, no ventral tooth or emargination; spatha rather wide and strongly narrowing posteriorly, at centre two and a half times as wide as sagitta; squama strongly transverse, short and rounded off externally, longer but also rounded off internally, inner edge emarginate, with a narrow, subacute anterior lobe, not projecting far inwards beyond the stipes; lacinia projecting a moderate distance beyond squama, rather narrow, moderately curved inwards, apex with small, inner hook-like projection, outer edge with rather dense hairs; volsellar region without dense bristles.

Illustrations. Sting—Text-fig. 21. Gastral sternites 7 and 8—Franklin, 1913: fig. 153; Text-figs. 22, 23. Genitalia—Franklin, 1913: figs. 178, 180.

Western S. AMERICA.



FIGS. 21-23. *Bombus funebris* Smith. 21, sting; 22, gastral sternite 7; 23, gastral sternite 8.

Section *ODONTOBOMBUS* Krüger

This group of subgenera has always been rather difficult to deal with and its members are on the whole more uniform than those of the previous sections. The males are often distinct, though it is not always easy to decide to what level of divergence subgeneric rank should be given, but the characters of the females are much less pronounced and it is difficult to make a useful key to them. The arrangement adopted below is provisional ; it seemed, at this stage, it might be better to define as many groups as possible ; it would not be difficult later to sink some of them.

23. *MEGABOMBUS* von Dalla Torre, 1880

*Hortobombus* Vogt, 1911

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons finely and rather closely punctured, unpunctured areas small and well-defined, a wide band of fine sculpture along inner margins of eyes. Dorsal furrow of gena occasionally developed as in *B. gerstaeckeri* Morawitz. Antennae with segments 3 : 4 : 5 =  $10\frac{1}{2}$  : 5 : 6, segment 3 nearly or quite three times as long as broad. Clypeus elongate, swollen dorsally, flattened ventrally, general surface little punctured, several rows of minute punctures along dorsal third of mid line, apical impressions feeble but more closely punctured. Labrum with tubercles rounded, little convex, largely smooth, furrow narrow but shallow, lamella rather broad and margin gently curved. Mandibles with no incisura, sulcus obliquus strong or moderate. Malar space very elongate (= 21), about as long as antennal segments 2 + 3 + 4. Mid basitarsus with apical dorsal angle spinosely produced. Hind tibia with corbicular surface bare and shining, inner dorsal apical angle with a short, wide, sharp process. Hind basitarsus with apical dorsal angle spinosely produced, surface rather more bristly than usual. Gastral tergite 6 shining, finely or coarsely granulate, often with a preapical furrow. Sting with outer thickenings of the sheath rather narrow throughout, more or less blackened near centre, inner thickenings rather strongly widened below, rather suddenly narrowed just above the middle, margins just above and below this extensively blackened, intervening membrane raised into a lobe on each side and strongly blackened at end of lobe opposite the point where the inner thickenings are narrowed. Wings evenly but only in a few species strongly infusate.

♂. Relatively large. Eyes not at all swollen, ocelli separated by three diameters from eyes, lying on the postocular line. Antennae long, segments 3 : 4 : 5 : 8 = 8 :  $4\frac{1}{2}$  :  $7\frac{1}{2}$  :  $7\frac{1}{2}$ , penultimate segments each a little curved. Mandibles with one broad ventral and one small dorsal tooth, beard long and dense. Malar space very elongate (= 16), about as long as antennal segment 2 + 3 + 4, unpunctured. Mid basitarsus moderately long (=  $38 \times 9$ ) and slightly narrowed at each end. Posterior apical angle just less than a right angle, fringes short. Hind tibia distinctly flattened, disk with rugose margins from which the hairs arise, somewhat dull and very finely reticulate, both fringes long. Hind basitarsus rather broad (=  $36 \times 13$ ), apical posterior angle about  $80^\circ$ , fringes short. Hairs of gaster rather long and dense. Gastral sternite 6 with apical margin a little thickened and recurved, hardly truncate. Gastral sternite 7 widely crescentic, central third of hind margin a little more produced, two large and narrowly separated patches of long, black bristles, no lines or fenestrae. Gastral sternite 8 with a wide base and central quarter with a tongue-like process, sides a little concave, apex straight, large apical area of short bristles, two parallel lines, no fenestrae. Genitalia rather large ; stipes with inner impressions small and not well-defined ; sagittae in dorsal view narrow, distal half serrate on lower outer edge, tip not hooked, sagitta in side view widening only at base, no ventral emargination or tooth ; spatha narrow for most of its length, hardly wider than sagitta, sides scarcely convergent ; squama large, projecting far beyond stipes, on inner side a wide, curved upright lamella which defines and two-thirds encloses an

oval area, all corners rounded but anterior end produced upwards into a sharp spike; lacinia rather narrow, extending well beyond squama, curved inwards, tip with a peculiar process rather like the "toe of Italy", volsellar region with stout, not very dense bristles.

Illustrations. Sting—Richards, 1927: fig. 46; Hazeltine & Chandler, 1964: pl. 3. Gastral sternites 7 and 8—Frison, 1935: figs. 2d, e, 3c, d; Pittioni, 1939a: pl. 1, fig. 1. Genitalia—Krüger, 1920: pl. 5, fig. a; Richards, 1927: fig. 26; Frison, 1935: figs. 2c, 3b; Pittioni, 1939a: pl. 1, fig. 1.

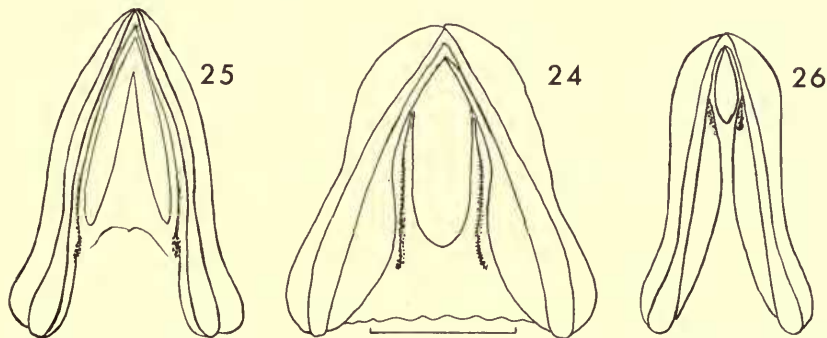
EUROPE TO CHINA and JAPAN, apparently not south of China.

[*Bombus melanopoda* Cockerell is a true *Megabombus* and was described from Sumatra. The record requires substantiation though the type exists in the British Museum and there is no obvious reason to doubt the label.]

#### 24. *DIVERSOBOMBUS* Skorikov, 1914

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons anteriorly shining, coarsely and moderately closely punctured, posteriorly dull, very closely and finely punctured, unpunctured areas rather small and well-defined, a moderately broad band of fine sculpture along inner margin of eyes. Dorsal furrow of gena occasionally indicated. Antennae with segments 3 : 4 : 5 = 9 : 4 : 7, segment 3 two and a half times as long as broad. Clypeus elongate, swollen, finely and generally rather sparsely punctured, apical impressions feeble with rather closer punctures. Labrum with tubercles moderately convex and angled at inner end, furrow rather deep and narrow, narrower than length of antennal segment 3, lamella wide, little curved. Mandibles with no incisura, sulcus obliquus strong. Malar space very elongate (= 16), longer than antennal segments 2 + 3, nearly as long as 2 + 3 + 4, with a few scattered fine punctures. Mid basitarsus with apical dorsal angle spinosely produced. Hind tibia with corbicular surface bare, feebly reticulate, inner dorsal angle very feebly produced. Hind basitarsus with dorsal apical angle not very acute, bristles all short. Gastral tergite 6 moderately shining, coarsely granulate, apex often with a small convex boss. Sting with outer thickenings of sheath moderately widened, especially above, inner thickenings strongly, almost angularly, widened, widest well below middle, not blackened, intervening membrane hardened and darkened dorsally. Wings evenly infusate.

♂. Very small compared with ♀. Eyes not at all swollen, ocelli separated by three diameters from eyes, lying just in front of postocular line. Antennae very long, each segment after fourth slightly curved, segments 3 : 4 : 5 : 8 = 6 : 4 : 7½ : 7½. Mandibles with one large ventral and one small dorsal tooth, beard dense, moderately long. Malar space very elongate (= 13), as long as antennal segments 2 + 3, with sparse fine punctures throughout. Mid basitarsus (= 44 × 8½) rather long and narrow, slightly narrowed at each end, apical dorsal



FIGS. 24-26. Stings of, 24, *Bombus diversus* Smith; 25, *B. senex* Vollenhoven; 26, *B. tricornis* Radoszkowsky.

angle a right angle, fringes short. Hind tibia only slightly convex, shining, most of surface with sparse, rather short bristles but a narrow, subapical disk bare, fringes moderately long and stout, not very dense. Hind basitarsus ( $= 43 \times 13$ ) moderately broad, considerably narrowed at base, apical dorsal angle just less than a right angle, fringes short. Hairs of gaster often relatively sparse. Gastral sternite 6 with apex very slightly thickened, not recurved, rounded, with a moderately dense postapical fringe. Gastral sternite 7 crescentic; posterior margin rounded, with two rather approximated patches of moderately long bristles. Gastral sternite 8 considerably produced but sides of produced part clearly convergent, apex weakly angulated, angles almost rounded, a large apical patch of dense, short bristles. Genitalia relatively large and elongate; stipes with a well-marked inner impression for more than half its width; sagittae in dorsal view relatively narrow, somewhat sinuate in then out, apex bent down and with a well-marked transverse flange on outer side, top of flange forming a small tooth, sagitta in side view much broader, especially at base, emarginate beneath but end of emargination hardly forming a tooth; spatha long and narrow, about as wide as sagitta, sides subparallel; squama mostly narrow and transverse with its posterior margin curved parallel with end of stipes, posterior inner end produced into a rounded thumb-shaped process, anterior inner end produced into a long curved hook extending as far back as posterior margin; lacinia proximally narrow, curved, parallel-sided, posteriorly with a characteristic spur-like process with a posterior spike and anterior crescentic serrate process, another external sub-triangular spike preceding the posterior one; volsella region with long, moderately dense bristles.

Illustrations. Sting—Text-fig. 24. Gastral sternites 7 and 8—Frison, 1934: figs. 7c, d. Genitalia—Frison, 1934: fig. 7a.

#### ASIA.

### 25. *SENEXIBOMBUS* Frison, 1930

♀. Ocelli separated by about three diameters from eyes, lying a little in front of postocular line. Frons moderately closely and strongly punctured, very finely and closely behind the ocelli, rather less close and more shining at sides, unpunctured areas large, not well-defined, no band of fine sculpture along inner margin of eyes. Dorsal furrow of gena absent. Antennae with segments 3 : 4 : 5 = 10 : 5 : 5, segment 3 two and a half times as long as broad. Clypeus moderately elongate, not much swollen, closely and coarsely punctured on dorsal third, rest unpunctured, apical impressions large, deep, moderately coarsely punctured. Labrum with tubercles moderately raised and angulated at inner end, shining, coarsely punctured, furrow wide and shallow, wider than length of antennal segment 3, lamella straight-edged, very wide. Mandibles with a very weak incisura and a strong sulcus obliquus. Malar space about quadrate ( $= 15$ ), longer than antennal segment 3 but about as long as  $2 + 3$ , with numerous fine punctures, especially on the lower half. Mid basitarsus with apical dorsal angle acutely spinose. Hind tibia with corbicular surface bare, very weakly convex, feebly reticulate, inner dorsal apical angle strongly produced. Hind basitarsus with apical dorsal angle acute, without long bristles. Gastral tergite 5 rather closely and coarsely punctured, tergite 6 feebly granulate, moderately shining. Sting with outer thickenings of sheath rather wide, even wider dorsally, inner thickenings rather narrow, moderately wide in middle, narrowing above and below, upper half blackened, blackening at about the middle, with a small downwardly directed process projecting into the membrane which is thrown into two folds. Wings feebly infusate or yellow-brown.

♂. Relatively large. Eyes not swollen, ocelli separated by three diameters from eyes, lying just on the postocular line. Antennae very long, segments 3 : 4 : 5 : 8 =  $7\frac{1}{2}$  : 5 : 12 : 11 $\frac{1}{2}$ , penultimate segments each a little curved. Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space considerably longer than broad ( $= 13$ ), just longer than antennal segment 5, closely and relatively strongly punctured except for a small antero-dorsal patch. Mid basitarsus ( $= 54 \times 14$ ), long, a little narrowed at each end,

apical dorsal angle acute, fringe shorter than basal width. Hind tibia not very clavate or convex, densely hairy with feathered hairs of moderate length, both fringes long and dense. Hind basitarsus (=  $60 \times 18$ ) considerably narrowed to base, apical dorsal angle acute, fringes short. Gaster with short rather dense hairs, tergites 1-5 with margins pale, almost white. Gastral sternite 6 with apex a little thickened and truncate. Gastral sternite 7 widely crescentic with two closely approximated patches of short bristles, no lines or fenestrae. Gastral sternite 8 considerably produced but sides of production diverging anteriorly, apex feebly emarginate, its angles rounded, a moderate apical patch of dense short bristles, a short longitudinal line on disk and sometimes two small fenestrae on each side. Genitalia large; stipes narrow distally, with wide but ill-defined depressions; sagitta narrow in dorsal view, bent down at apex but not curved or widened, outer side serrate on posterior third, first tooth of serration much larger, in side view about twice as wide (except quite near base) emarginate beneath to form a strong angle near centre; spatha very narrow hardly wider than sagitta, sides scarcely convergent; squama very large, obliquely transverse, outer end rounded-rectangular, inner end produced into a large hook-like lobe extending well anteriorly to end of stipes, inside the hook can be seen a downwardly directed bifid process, the outer division of which is longer and more acute than the inner one; lacinia rather narrow, curving inwards, apex narrow, curved upwards and outwards into a small hook, inner side with a long dense regular fringe continuous with a dense, long, posterior volsellar tuft.

Illustrations. Sting—Text-fig. 25. Gastral sternites 7 and 8—Frison, 1928: pl. 1, figs. 2, 3; Frison, 1930: figs. 2, 3. Genitalia—Frison, 1928: pl. 1, fig. 1; Frison, 1930: fig. 1.

#### EAST INDIES.

### 26. *TRICORNIBOMBUS* Skorikov, 1922

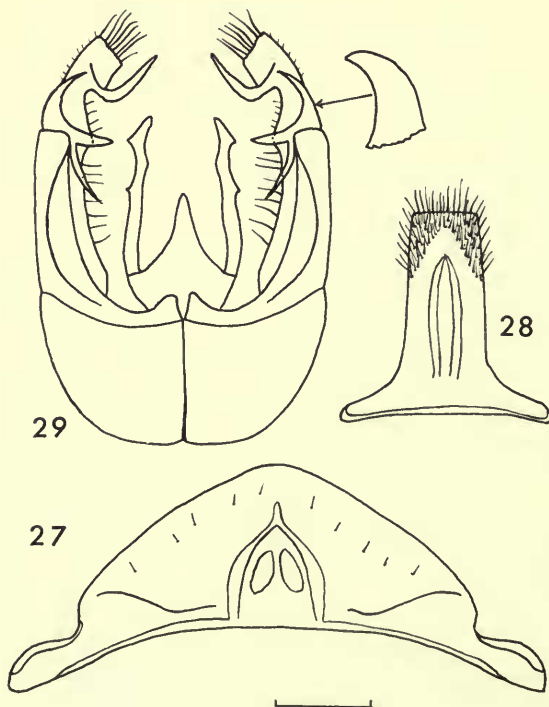
♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons anteriorly rather closely and coarsely punctured, behind ocelli (also laterally) very closely and rather coarsely punctured, unpunctured areas rather small and well-defined, a wide band of close fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennae with segments  $3 : 4 : 5 = 7\frac{1}{2} : 4\frac{1}{2} : 5\frac{1}{2}$  or (*B. atripes* Smith,  $7\frac{1}{2} : 5\frac{1}{2} : 6\frac{1}{2}$ ) segment 3 not quite two and a half times as long as broad. Clypeus elongate, little swollen, closely and mostly quite strongly punctured, only a small ventral disk smooth, apical impressions rather feeble with close, coarse punctures. Labrum with tubercles only moderately raised, rather flattened, not angled, large outer area smooth, furrow very wide and shallow, at least as wide as length of antennal segments  $2 + 3$ , lamella very wide, feebly curved. Mandibles with no incisura and a strong sulcus obliquus. Malar space, longer than broad (= 12 or *B. atripes* Smith, 14), about as long or nearly as long as antennal segments  $3 + 4$  with a few fine punctures. Mid basitarsus with apical dorsal angle spinosely produced. Hind tibia with corbicular surface bare, hardly at all convex, distinctly reticulate, inner dorsal apical angle strongly produced. Hind basitarsus with apical dorsal angle distinct but short, bristles short. Gastral tergites very closely and coarsely punctured almost throughout except for narrow apical bands, tergite 6 dull, reticulate and with sparse, coarse granules, dense hairs more confined to sides than usual. Sting with outer thickenings only widened dorsally, inner thickenings very wide, bent inwards, becoming rather suddenly very narrow dorsally and at this point a bit blackened, membrane generally undifferentiated, but a convex central fold at dorsal end. Wings evenly infusate, sometimes strongly so.

♂. Relatively small. Eyes not swollen, ocelli separated by three diameters from eyes, lying on postocular line. Antennae moderately long, segments  $3 : 4 : 5 : 8 = 4 : 4 : 7 : 8$  or  $6\frac{1}{2} : 6\frac{1}{2} : 9\frac{1}{2} : 12$ , penultimate segments all distinctly curved. Mandibles with a broad ventral and small dorsal tooth, beard rather long. Malar space a little longer than broad (= 8 or 9), about as long as antennal segments  $3 + 4$ , scarcely or quite strongly punctured. Mid basitarsus (=  $39 \times 9$  or  $55 \times 13$ ) relatively long and parallel-sided, apical dorsal angle

rounded or subacute, fringes short. Hind tibia with corbicular surface convex, shining, granulate with coarse hairs throughout, fringes short but of very stout bristles. Hind basitarsus (*B. atripes* =  $61 \times 17$ ) moderately long and parallel-sided, apical dorsal angle acute, fringes short. Gaster with short, not very dense hairs, sculpture more or less granulate or confluent punctured. Gastral sternite 6 with apex widely rounded, thickened and a bit recurved. Gastral sternite 7 widely or long crescentic, apex sometimes a little produced, with a few black-based bristles, no or two converging lines, no or two small fenestrae. Gastral sternite 8 strongly produced, production almost parallel-sided, apex straight or nearly rounded, with a large apical patch of dense short bristles, two parallel lines on disk, sometimes with an oval fenestra at base. Genitalia not large; stipes with distal angle produced inwards, inner impression strong and sharp-edged, two-thirds its width; sagitta in dorsal view rather narrow, distinctly so on bent down apical part which is not hooked but has a wide, feebly serrate, outer flange, in lateral view sagitta wide with a deep emargination at centre, ending in a tooth, beyond this emarginate again before the flange; spatha wide, at centre one and a half times as wide as sagitta, sides strongly converging; squama with an outer rounded lobe set in an oblique plane, considerably or only a little longer than broad, very narrow where it adjoins inner half of stipes, at a much lower level produced on inside into two long, very acute lobes, directed obliquely forwards and backwards, or one downwards and the other obliquely upwards; lacinia very wide, not extending very far beyond the squama, on inner side proximally with a very long acute hook, edge beyond the hook straight truncate, a bit serrate with rather long bristles; volsellar region with long, moderately dense bristles.

Illustrations. Sting—Text-fig. 26. Gastral sternites 7 and 8—Text-figs. 27, 28. Genitalia—Text-fig. 29.

East ASIA, mostly northern.



FIGS. 27-29. *Bombus tricornis* Radoszkowsky. 27, gastral sternite 7; 28, gastral sternite 8; 29, genitalia.



27. *LAESOBOMBUS* Skorikov, 1922

The males of this subgenus are easily recognized but it is not certain that the females can be distinguished from all members of subgenus *Thoracobombus*.

♀. Ocelli separated by about three diameters from eyes, lying just in front of postocular line. Frons anteriorly strongly and not very closely punctured, posteriorly much more finely and closely, unpunctured areas rather large and well-defined, a narrow band of fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 9 : 4\frac{1}{2} : 5$ , segment 3 about two and a half times as long as broad. Clypeus about as long as broad, rather swollen, with quite numerous punctures, mostly small but a few rather larger, apical impressions moderately distinct with close, large punctures. Labrum with tubercles flattened and very little raised, not at all angled, furrow wide and shallow, not quite as wide as length of antennal segment 3, lamella not strongly marked, half as wide as labrum, little curved. Mandibles with a weak incisura and a strong sulcus obliquus. Malar space about quadrate (= 10), distinctly shorter than antennal segments  $2 + 3$ , scarcely punctured. Mid basitarsus with apical dorsal angle spinosely produced. Hind tibia with corbicular surface slightly convex on basal half, shining, not reticulate, inner dorsal apical angle with a strong but not very acute projection. Hind basitarsus with dorsal apical angle acutely spinose, bristles all short. Gastral tergite 6 moderately shining, coarsely granulate, not at all upturned at apex. Sting with outer thickenings of sheath not wide but somewhat more so dorsally, inner thickenings moderately widened over most of dorsal half, slightly blackened, membrane undifferentiated. Wings slightly and evenly darkened.

♂. Eyes not swollen, ocelli separated by three diameters from eyes, lying a little in front of postocular line. Antennae long, segments  $3 : 4 : 5 : 8 = 4\frac{1}{2} : 7 : 8\frac{1}{2} : 9\frac{1}{2}$ , individual segments a little convex below. Mandibles with broad ventral and small dorsal tooth, beard rather long and dense. Malar space just longer than broad (=  $6\frac{1}{2}$ ), about as long as antennal segment 4, practically unpunctured. Mid basitarsus (=  $35 \times 8\frac{1}{2}$ ) not long, moderately broad, dorsal apical angle moderately acute, fringes short. Hind tibia almost flat, mostly a little dull, more shining and concave on distal quarter where it is considerably widened, whole surface with sparse short bristles, fringes, especially dorsal one, long. Hind basitarsus (=  $37 \times 11$ ) rather short and broad, dorsal edge feebly curved, dorsal apical angle distinct, no long bristles. Gaster with hairs short and dense, tergites finely but not rugosely punctate. Gastral sternite 6 with margin a little thickened, not recurved, with short, dense, pale, postapical fringe. Gastral sternite 7 crescentic with central part of margin a little produced and bisinuate, with a large continuous area of short bristles, no lines or fenestrae. Gastral sternite 8 narrow with a strongly produced central part which is approximately quadrate, with sides, apical margin and angles a little rounded, whole produced part with short bristles, two parallel lines on disk, no fenestrae. Genitalia rather elongate; stipes wide, especially distally, inner impressions very weak; sagitta in all views narrow except right at base, a little pointed and downcurved at apex, not serrate nor toothed beneath; spatha broad, short, rapidly narrowing at centre, much wider than sagitta; squama highly differentiated, large outer part mainly pale and submembranous, generally transverse, posteriorly produced into a wide rounded lobe, anterior to this the inner edge deeply emarginate and produced into an elaborate process which bears a long acute spine directed obliquely forwards and above this a large subcircular lobe (mainly in the vertical plane) with its dorsal edge serrate and the whole attached to the squama by a narrow stalk; lacinia long and broad, projecting far beyond squama, broadly digitiform with end obliquely truncate, inner edge feebly emarginate and weakly serrate, opposite end beneath the rounded process of the squama produced inwards into a strong, parallel-sided process with its end moderately expanded and with sharp angles; inner side of lacinia and volsellar region with rather dense stout bristles.

Illustrations. Sting—Text-fig. 30. Gastral sternites 7 and 8—Pittioni, 1939a : pl. 2, fig. 4. Genitalia—Krüger, 1920 : pl. 6, fig. i; Pittioni, 1939a : pl. 2, fig. 4.

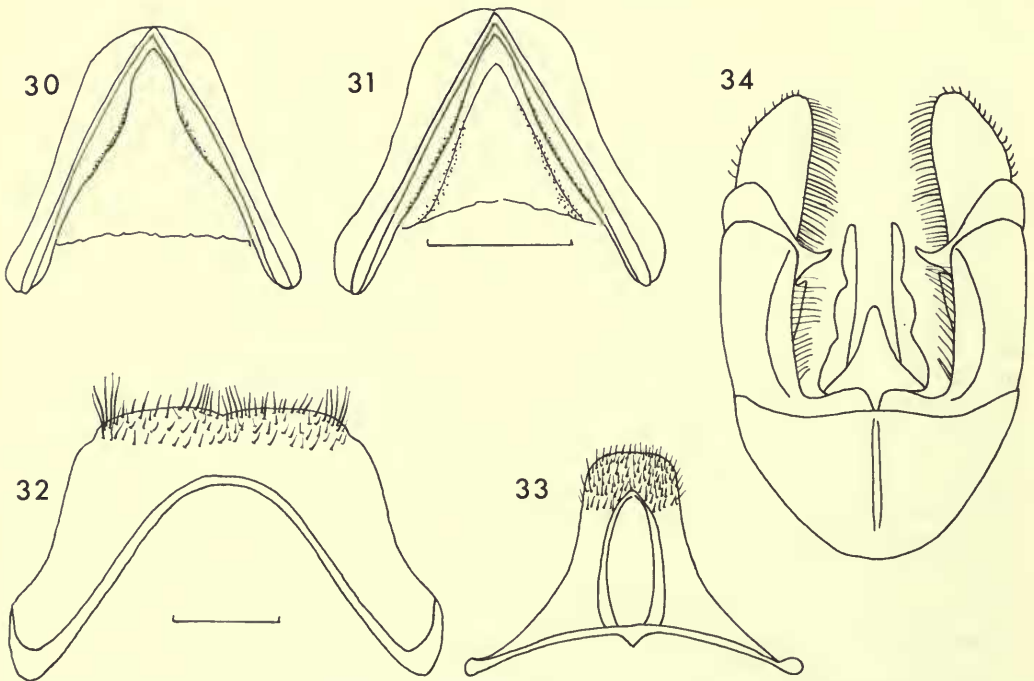
SPAIN and N. AFRICA to central U.S.S.R.

28. *EVERSMANNIBOMBUS* Skorikov, 1938

I am uncertain of the status of this group without further study of allied forms. Its characters are, however, listed.

♀. Ocelli separated by rather more than three diameters from eyes, lying just in front of the postocular line. Frons rather closely and strongly punctured, unpunctured areas small and well-defined, the areas narrowed from in front so that they are laterally pointed, two thirds of the space to the eye with very dense fine punctures. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 9\frac{1}{2} : 5 : 5$ , segment 3 not quite three times as long as broad. Clypeus long, moderately swollen with rather numerous punctures, many large, apical impressions small with a narrow band of close punctures. Labrum with tubercles little raised or angled, somewhat flattened, furrow moderately wide and deep, not quite as wide as length of antennal segment 3, lamella wide, straight, but not prominent. Mandibles with no incisura, sulcus obliquus strong. Malar space just longer than quadrate ( $= 12$ ), just longer than antennal segment 3, much of it finely punctured. Mid basitarsus with apical dorsal angle not strongly spinose. Hind tibia with corbicular surface not reticulate, inner apical dorsal angle with a small acute process. Hind basitarsus with apical dorsal angle moderately acute, no long bristles. Gastral tergite 6 moderately shining, moderately coarsely and closely granulate. Sting with outer thickenings of the sheath rather narrow, somewhat wider above, inner thickenings narrow, somewhat widened on central two thirds, and the centre of this part of margin somewhat blackened, the adjacent membrane also a bit blackened but otherwise undifferentiated. Wings moderately infusate.

♂. Relatively large. Eyes not swollen, ocelli separated by three diameters from eyes, lying just in front of postocular line. Antennae long, segments  $3 : 4 : 5 : 8 = 6\frac{1}{2} : 5 : 7 : 7\frac{1}{2}$ ,



FIGS. 30-34. 30, Sting of *Bombus laesus* Morawitz; 31-34, *B. evermanniellus* Skorikov, 31, Sting; 32, gastral sternite 7; 33, gastral sternite 8; 34, genitalia.

penultimate segments hardly curved. Mandibles with a large ventral and a small dorsal tooth, beard long and dense. Malar space much longer than broad ( $= 8\frac{1}{2}$ ), about as long as antennal segments  $2 + 3$ , shorter than  $3 + 4$ , with quite numerous strong punctures. Mid basitarsus moderately long nearly parallel-sided ( $= 38 \times 9$ ), apical dorsal angle a right angle, fringes short. Hind tibia feebly clavate, rather convex, disk shining with rather sparse coarse, bristle-bearing punctures, fringes shorter than the width of tibia. Hind basitarsus moderately long and broad ( $= 40 \times 14$ ), apical dorsal angle just acute, all bristles short. Gaster with close coarse punctures and some reticulations, hairs rather long and dense. Gastral sternite 6 flat, apex a little thickened, subtruncate, postapical fringe short, dense, pale. Gastral sternite 7 widely crescentic, apex rounded, practically whole surface with short bristles which along apical margin are longer and feathered, a central thickened line and a darker spot on each side of base, no fenestra. Gastral sternite 8 with a strong tongue-shaped projection, sides a little concave, apex rounded-truncate, practically the whole process with dense bristles which become dense at centre of sides, usually with a very large lanneolate fenestra with thickly margined sides, for two-thirds of its length. Genitalia rather long and large; stipes long and wide with inner impressions very feeble; sagitta in dorsal view narrow, not much curved down at end, slightly widened over central fifth and again on apical fifth, this apical part forming a slight, very feebly serrate, lateral flange, apex hardly acute, sagitta in side view with basal half very wide, suddenly narrowed and after a small emargination produced into a wide straight truncate lobe, then another small emargination before the apical flange; squama small, transversely crescentic, sides and posterior margin in one continuous curve, squama almost evanescent at inner posterior end of stipes but produced here inwards into a moderately acute process which in a more anterior view forms an obliquely-lying plate, the dorsal edge of this plate forming a continuous S-shaped curve with posterior margin of squama; lacinia long and broad, thumb-shaped, inner edge nearly straight with very dense curved, feathered bristles which are half as long as its width, outer edge more curved, apex narrowly rounded; volsellar region also with dense bristles.

Illustrations. Sting—Text-fig. 31. Gastral sternites 7 and 8—Text-figs. 32, 33; Pittioni, 1937: fig. 2. Genitalia—Text-fig. 34; Pittioni, 1937: fig. 1.

#### EASTERN EUROPE.

### 29. *EXILOBOMBUS* Skorikov, 1922

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons moderately strong but rather sparsely punctured, shining but with a very faint reticulation, unpunctured areas large, fairly well defined, inner margin of eye with a band of microscopic punctures which broadens posteriorly and spreads almost half way across unpunctured area though the fine punctures here are not very dense. Dorsal furrow of gena absent. Antennal segments  $3 : 4 : 5 = 8 : 4 : 4$ , segment 3 two and a half times as long as broad. Clypeus a little longer than broad, somewhat convex, with numerous punctures, many of them large, apical impressions very narrow but rather deep, closely punctured. Labral tubercles little raised, smooth and rounded, hardly punctured, furrow broad and shallow, about as broad as length of antennal segment 3, lamella broad and straight, considerably thickened. Mandibles with a distinct sulcus, incisura weak, basal area closely, aciculate punctured. Malar space a little longer than broad ( $= 10$ ), longer than antennal segment 3, nearly as long as  $2 + 3$ , unpunctured. Mid basitarsus strongly and acutely produced. Hind tibia with corbicular surface bare, shining, excessively finely reticulate, dorsal inner apical angle strongly produced, hind basitarsus with dorsal angle quite strongly produced, surface shining not very densely pubescent, margins without long bristles. Gastral tergite 6 dull, very finely and densely reticulate, with fine sparse punctures. Sting with outer thickenings of sheath wide above, narrow below, inner thickenings moderately widened on lower half, narrow on upper half, transition very gradual, thickenings separated from sheath by a narrow paler area, edge of

narrow part of thickening a little darkened near mid point, membrane hardly differentiated, with two somewhat darkened lobes above. Wings feebly infuscate.

♂. Not seen.

Illustrations. Sting—Text-fig. 35.

EASTERN MONGOLIA and USSURI district.

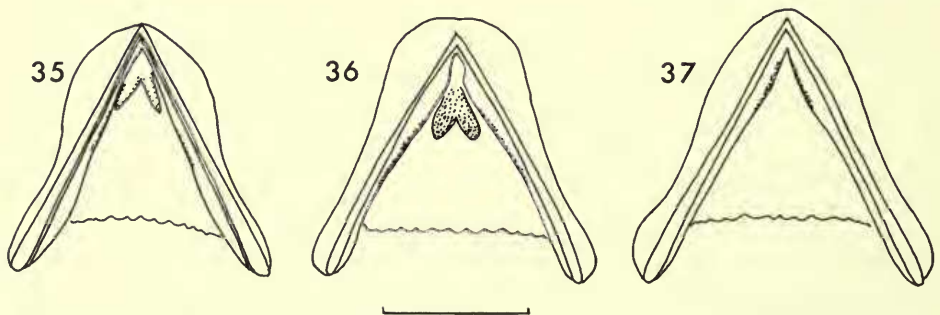
### 30. *ADVENTORIBOMBUS* Skorikov, 1922

The status of this group is very doubtful. Originally it seems to have been intended for all the species of *Agrobombus* Vogt (= *Thoracobombus*) which do not have a serrate sagitta in the male, that is for all of them except *B. pascuorum* (Scopoli) (= *agrorum* (Fabricius)). This is a large and very diverse group of species but as it happens *B. adventor* (Skorikov) is unusually distinct in the female (the ♂ has not been available for study). Whether this species should form a separate subgenus or whether it and perhaps some other groups should all be united under *Thoracobombus* will have to be determined in the future. The female is described below.

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons anteriorly with rather sparse, coarse punctures, posteriorly dull, finely and closely punctured, unpunctured areas small, moderately well-defined, a wide band of close, fine sculpture along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 =  $7\frac{1}{2} : 4\frac{1}{2} : 5$ , segment 3 about twice as long as broad. Clypeus elongate, swollen, with rather sparse, scattered punctures, mostly small, apical impressions very feeble with a row or two of moderately close punctures. Labrum with tubercles flattened and rounded, furrow rather narrow, clearly narrower than length of antennal segment 3, lamella inconspicuous. Mandibles with no incisura and a strong sulcus obliquus. Malar space distinctly longer than broad (= 14), at least as long as antennal segments 3 + 4, unpunctured. Mid basitarsus with apical dorsal angle long, spinose. Hind tibia with corbicular surface rather convex on basal half, shining, not reticulate, inner dorsal apical angle produced into a rather wide process. Hind basitarsus with apical dorsal angle quite strong, dorsal margin with some long bristles near base. Gastral tergite 6 upturned at apex, shining, with sparse, coarse, granulations. Sting with outer thickenings of sheath somewhat wider dorsally than ventrally, inner thickenings widening very gradually upwards, widest near top, then rather suddenly narrowing, a slight blackening of edge near centre, membrane with small central folds at top. Wings subhyaline.

Illustration. Sting—Text-fig. 36.

INNER MONGOLIA.



FIGS. 35-37. Stings of, 35, *Bombus exilis* Skorikov ; 36, *B. adventor* Skorikov ; 37, *B. mucidus* Gerstäcker.

31. *THORACOBOMBUS* von Dalla Torre, 1880

*Chromobombus* von Dalla Torre, 1880

*Agrobombus* Vogt, 1911

This is a large group with a considerable range in structure. Only some of the species have been examined and the characters given here are probably not found in all of them. It might have seemed natural to adopt the subgenus *Chromobombus* but the type-species *Bombus muscorum* Linnaeus raises a nomenclatorial problem because the ostensible type in the Linnean collection differs from the usual conception of the species. There is no doubt about the type-species of *Thoracobombus*, namely *Apis sylvarum* L., though it is a somewhat peripheral member of the group.

♀. Ocelli separated by three diameters from eyes, lying about on the postocular line. Frons shining and somewhat swollen in front with coarse, not very close punctures, posteriorly with very close rather fine punctures, unpunctured areas of moderate size, well-defined, a rather wide band of close fine punctures along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 about = 7 : 4½ : 5, segment 3 twice as long as broad. Clypeus clearly longer than broad, swollen, with more or less fine, scattered punctures, apical impressions rather strong with close, moderately coarse punctures. Labrum with tubercles flattened and rounded, inner ends rounded, shallow furrow, rather less wide than length of antennal segment 3, lamella very wide and straight, sharp-edged or with edge thickened. Mandibles with no incisura, sulcus obliquus strong. Malar space distinctly longer than broad (= 12), about as long as antennal segments 3 + 4, with scattered fine punctures, especially on distal half. Mid basitarsus acutely spinosely produced. Hind tibia a little convex, not reticulate, inner dorsal apical angle distinctly produced. Hind basitarsus with short, rather sparse hairs, dorsal angle acute. Gastral tergite 6 moderately shining, finely granulate, a little upturned at apex. Sting with outer thickenings of sheath moderately wide, especially above, inner thickenings strongly widened upwards from below in *B. sylvarum* but considerably narrower in many other species, the middle of the broadest part sometimes projecting as a slight spur and margin below this slightly blackened, membrane undifferentiated. Wings evenly but usually only slightly infusate.

♂. Of moderate size. Eyes not swollen, ocelli separated by three diameters from eyes, lying on postocular line. Antennae moderately long, segments 3 : 4 : 5 : 8 typically 6½ : 4½ : 8 : 8 but varying specifically, penultimate segments slightly or (*B. pascuorum* (Scopoli)) strongly thickened beneath. Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space distinctly longer than broad (= 8½), a little shorter than antennal segments 3 + 4, with scattered fine punctures. Mid basitarsus moderately long and parallel-sided (40 × 10), dorsal apical angle acute, fringes short. Hind tibia not very clavate, surface convex, cross-striate, not very shining, with dense, moderately long hairs throughout, dorsal fringe very long. Hind basitarsus moderately long and broad (43 × 13), apical dorsal angle subacute, all bristles short. Gaster with dense, moderately long hairs, with granulate punctures, rather dull. Gastral sternite 6 feebly truncate. Gastral sternite 7 transverse rather than crescentic, side apical border with rather long bristles, no fenestrae but sometimes a little thinner on oval areas each side of mid-line. Gastral sternite 8 produced into a wide, almost parallel-sided process, apex just rounded, angles rounded, with a very large area of dense short hairs, no fenestrae but a thickened central line. Genitalia of moderate size ; stipes with no definite impressions ; sagitta in dorsal view narrow, not much desclerotized, apex hardly bent down, usually with small, outwardly directed, pointed hook and no flange, but in *B. pascuorum* (Scopoli) with a long, narrow, serrate flange, sagitta in side view very wide at base, then narrower with an emargination before the central tooth, beyond this narrow to apex ; spatha narrowing very soon behind base, mostly about one and a half times as wide as sagitta ; squama generally large, subquadrate with outer edge rounded to apex, details varying specifically but inner side produced obliquely into a downwardly directed acute plate

or spike ; lacinia wide but not very long, not projecting much beyond squama, inner edge at apex produced into a small process and at centre into a spike or a narrow, truncate process, bristles short and not dense ; volsellar area with some long bristles posteriorly.

Illustrations. Sting—Richards, 1927 : figs. 50, 51, 52, 53 ; Hazeltine & Chandler, 1964 : pl. 5. Gastral sternites 7 and 8—Radoszkowsky, 1884 : figs. 20c, 21c, 22c ; Richards, 1927 : figs. 22, 24 ; Pittioni, 1939a : pl. 1, figs. 4, 5, 6, pl. 2, figs. 1, 2, 3. Genitalia—Radoszkowsky, 1884 : figs. 20 a, b, 21 a, b, 22 a, b ; Krüger, 1920 : pl. 5, figs. g, f, h, pl. 6, figs. k, l ; Richards, 1927 : figs. 28, 29, 30, 31, 32 ; Pittioni, 1939a : pl. 1, figs. 4, 5, 6, pl. 2, figs. 1, 2, 3.

EUROPE to JAPAN, TIBET, but probably not south of the Chinese boundaries.

### 32. *MUCIDOBOMBUS* Skorikov, 1922

*Exilobombus* Skorikov, 1922 of which I have not been able to examine the male, may prove to be a synonym. As in the other groups allied to *Thoracobombus*, the males of *Mucidobombus* are rather distinctive but the females are difficult to separate subgenerically.

♀. Ocelli separated by rather more than three diameters from eyes, lying just in front of postocular line. Frons rather closely punctured, more strongly and less closely in front of ocelli, unpunctured areas moderately large, well-defined, a wide band of fine sculpture along inner margin of eyes. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 =  $7\frac{1}{2}$  :  $3\frac{1}{2}$  : 4, segment 3 rather more than two and a half times as long as broad. Clypeus elongate, moderately swollen, with scattered, not at all close, fine punctures, apical impressions feeble but with a narrow deeper strip with close, moderately large punctures. Labrum with tubercles flattened, inner ends moderately raised, rounded-angular, furrow moderately deep, not broad, narrower than length of antennal segment 3, lamella half the width of labrum, feebly curved, rather thin. Mandibles with almost no incisura, sulcus obliquus strong. Malar space somewhat longer than broad (= 11), not quite as long as antennal segments 2 + 3, a considerable number of scattered, minute punctures. Mid basitarsus strongly spinosely produced. Hind tibia with corbicular surface scarcely reticulate, a little convex towards base, inner apical dorsal angle acutely produced. Hind basitarsus with dorsal angle acute, all bristles short and not numerous. Gastral tergite 6 shining, weakly granulate. Sting with outer thickenings of sheath rather narrow, even dorsally, inner thickenings developed for whole length, very gradually widening upwards, widest just before the top and for a short distance below this somewhat blackened, membrane undifferentiated. Wings lightly infusate, darker towards tip.

♂. Relatively small. Eyes not swollen, ocelli separated by three diameters from eyes, lying on postocular line. Antennae with segments 3 : 4 : 5 : 8 =  $6\frac{1}{2}$  :  $3\frac{1}{2}$  : 7 :  $7\frac{1}{2}$ , penultimate segments a little curved. Mandibles with one broad ventral and a small dorsal tooth, beard long and dense. Malar space distinctly longer than broad (= 10), nearly as long as antennal segments 3 + 4, with scattered fine punctures. Mid basitarsus moderately long and parallel-sided (=  $31 \times 9$ ), apical dorsal angle acute, fringes short. Hind tibia distinctly clavate, convex, only a small distal disk bare though the hairs are not long elsewhere, dorsal fringe very long. Hind basitarsus short and broad (=  $35 \times 13$ ), dorsal apical angle acute, fringes very short. Gaster with long, rather dense hairs, moderately shining with rather close coarse punctures and some cross-striation. Gastral sternite 6 with apex rounded, a little thickened. Gastral sternite 7 transversely crescentic, apex rounded, with scattered short bristles, no lines or fenestrae. Gastral sternite 8 produced into a moderate process which is distally parallel sided, apex truncate, angles rounded, a large patch of hairs posteriorly, proximal half with two parallel lines on disk with a small fenestra between them. Genitalia relatively long ; stipes wide with feeble, ill-defined inner impressions ; sagitta narrow in dorsal view, curved down at apex where pointed though not very acutely, no flange or serration, in lateral view about twice as wide, no ventral emargination or tooth, but a slight projection at proximal

end of subapical flange ; spatha small, strongly narrowing posteriorly, at middle about as wide as sagitta ; squama large, transverse, outer and posterior margins forming a continuous curve, anterior inner end produced forwards and then obliquely downwards and backwards in a broad but acute spike ; lacinia very long and broad, generally finger-shaped but in centre of inner margin with a wide lobe, defined at each end by a small tooth, the posterior one very acute, end of lacinia subacute, inner edge and ventral surface with dense, quite long pubescence ; volsella region relatively bare.

Illustrations. Sting—Text-fig. 37. Gastral sternites 7 and 8—Pittioni, 1939a : pl. 2, fig. 5. Genitalia—Krüger, 1920 : pl. 5, fig. e ; Pittioni, 1939a : pl. 2, fig. 5.

EUROPE, WESTERN ASIA.

### 33. *SUBTERRANEOBOMBUS* Vogt, 1911

This subgenus has many species, especially in western and central Asia, and there is a considerable range in structure ; the malar space in particular varies greatly in length. The male genitalia, as far as they are known, though showing good specific differences are of the same general type.

♀. Ocelli separated by three diameters from eyes, lying about on the postocular line. Frons closely and rather finely punctured, unpunctured areas moderately large, well-defined, a wide band of fine sculpture along inner margin of eye. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 about = 9 : 4 : 6, segment 3 from rather under to fully three times as long as broad. Clypeus elongate, swollen, either little punctured or (*B. fragrans* (Pallas) ) closely and finely punctured throughout, apical impressions feeble, little punctured or (*B. difficillimus* Skorikov) closely and finely punctured. Labrum with tubercles smooth, flattened and considerably rounded or (*B. fragrans*) considerably more raised and angled at inner end, furrow rather wide, about three-quarters as wide as length of antennal segment 3, lamella moderately wide, curved. Mandibles with no incisura, sulcus obliquus strong. Malar space usually elongate or even very elongate, longer than antennal segments 2 + 3, about = 3 + 4 + 1/3 5 (= 15), but in *B. fragrans* hardly more than quadrate and about as long as antennal segments 2 + 3 (= 13). Mid basitarsus with its dorsal apical angle usually with a relatively short and broad spinose production. Hind tibia with corbicular surface shining, inner dorsal apical angle acute but relatively short and broad. Hind basitarsus with dorsal apical angle not very acute, bristles all short. Gastral tergite 6 not modified, more or less coarsely granulate, sometimes with a furrow on the posterior half. Sting with outer thickenings of sheath of even width, relatively narrow, inner thickenings rather strongly widened in a very even curve, widest at about the middle, a strong black patch just above this, membrane on each side thrown into a strong fold which extends down to the middle and almost touches both the inner thickening and its fellow from the other side. Wings evenly infusate, sometimes strongly.

♂. Relatively small. Eyes not swollen, ocelli separated by three diameters from eyes, lying just in front of postocular line. Antennae long or very long, segments 3 : 4 : 5 : 8 = 7-8 : 5 : 7½-8 : 8, penultimate segments somewhat or scarcely curved. Mandibles with a broad ventral and small dorsal tooth, beard long and dense. Malar space elongate, as long or longer than antennal segments 3 + 4 (= 11 or more), surface unpunctured. Mid basitarsus moderately long and parallel-sided (40 × 10 or 46 × 12), dorsal apical angle about a right angle, fringes short. Hind tibia with distal half flattened or even concave, covered either with short, not very close bristles, or with a considerable bare disk, fringes short or dorsal fringe long. Hind basitarsus relatively long and parallel-sided (= 41 × 13 or 47 × 13), dorsal apical angle just acute, bristles short. Hairs of gaster long or short, not very dense. Gastral sternite 6 with apex gently rounded, not thickened, with a dense, short, postapical fringe. Gastral sternite 7 widely and broadly crescentic with scattered bristles and closer short hair on disk, no lines or fenestrae. Gastral sternite 8 with a wide tongue-shaped process

on central third, sides almost parallel, apex just emarginate, with dense short hairs, two weak parallel lines but no fenestrae. Genitalia rather large; stipes with a deep, wide, sharp-edged, inner impression; sagittae in dorsal view generally narrow, apex a little curved downwards, a slight broadening at a lower level near centre and apex outwardly triangularly widened or with a triangular pointed flange, sagitta in side view broad on the basal half or rather more, then narrowed and emitting a process ending in two or three small points; spatha narrow, almost parallel-sided, about as wide as sagitta; squama transverse or transversely S-shaped, all angles, or at least the external ones, rounded, inner side sometimes produced into a vertical lamella which looks sharp in dorsal view; lacinia little or moderately projecting beyond squama, rather narrow, a little curved inwards, end pointed or almost rounded, sometimes with a small apical tuft; volsellar region with short dense bristles.

Illustrations. Sting—Franklin, 1913: fig. 157; Richards, 1927: fig. 49; Hazeltine & Chandler, 1964: pl. 6. Gastral sternites 7 and 8—Radoszkowski, 1884: figs. 26c, 36c; Franklin, 1913: fig. 138; Pittioni, 1939a: pl. 1, fig. 2. Genitalia—Radoszkowski, 1884: figs. 26a, b, 36a, b; Franklin, 1913: fig. 157; Krüger, 1920: pl. 5, figs. c, d; Richards, 1927: fig. 27; Pittioni, 1939a: pl. 1, fig. 2.

EUROPE, ASIA to the HIMALAYAS, N. AMERICA.

### 34. *RHODOBOMBUS* von Dalla Torre 1880

*Pomobombus* Krüger, 1917

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons finely, mostly not very closely punctured, a large area in front of median ocellus without punctures, unpunctured areas large but well-defined, a narrow band of fine punctures along inner margin of eye. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 = 9 : 4 : 4½, segment 3 two and a half times as long as broad. Clypeus elongate, moderately swollen, finely and rather sparsely though generally punctured, apical impressions small and narrow but rather well-defined, with a few close larger punctures, mostly in transverse rows. Labrum with tubercles somewhat flattened and rather rounded, furrow of moderate width, about three-quarters as wide as length of antennal segment 3, lamella wide, gently curved. Mandibles with no incisura, sulcus obliquus strong. Malar space elongate, about as long as antennal segments 2 + 3 (= 13½), with a certain number of scattered fine punctures. Mid basitarsus with its dorsal apical angle acutely spinose or in some American species only somewhat angled. Hind tibia with corbicular surface somewhat convex on posteroventral part, surface bare, weakly reticulate, inner dorsal apical angle not or scarcely produced. Hind basitarsus spinosely produced at dorsal apical angle, bristles short. Gastral tergite 6 finely granulate, moderately shining. Sting with outer thickenings of sheath rather narrow but somewhat widened above, inner thickenings evenly widened for most of their length, edge somewhat emarginate above. Wings usually moderately infusate.

♂. Size moderate. Eyes normal, ocelli separated by three diameters from eyes, lying just in front of postocular line. Antennae rather long, segments 3 : 4 : 5 : 8 = 6 : 4 : 7 : 7½, penultimate segments hardly curved. Mandibles with a broad ventral and a small dorsal tooth, surface granulate and dull, beard not developed. Malar space elongate, about as long as antennal segments 3 + 4 (= 9½), with scattered very fine punctures. Mid basitarsus moderately long and parallel-sided (34 × 8), dorsal apical angle a rounded right-angle, fringes short. Hind tibia thick and little clavate, surface convex and shining with scattered punctures and some cross-striation, with hairs over whole surface, fringes not dense nor longer than its width. Hind basitarsus moderately broad and parallel-sided (37 × 13), dorsal apical angle acute, fringes short. Gaster with close moderately short hairs. Gastral sternite 6 slightly thickened and truncate with a short subapical fringe. Gastral sternite 7 somewhat produced in a broad triangle with rounded apex, well behind apex darker transverse band running parallel to margin, moderate bristles arising on and before the band, no lines or fenestrae. Gastral



sternite 8 narrowly transverse with a strongly produced parallel-sided process, angles rounded, apex bifid though the emargination partly filled in by transparent membrane, with tufts of moderate bristles on each side, a pair of parallel lines on disk. Genitalia of moderate size; stipes with well-defined inner impression of half its width; sagittae in dorsal view rather narrow, not at all desclerotized, apex a little bent down, curved outwards into a truncate hook whose anterior end forms a small acute tooth, in side view at least twice as wide with a well-marked emargination after base and a strong acute tooth at middle; spatha moderately broad, gradually narrowing posteriorly, at centre one and a half times as wide as sagitta; squama transverse, outer edge curving obliquely inwards and ending in a stout acute process at inner posterior dorsal corner, inner edge from anterior inner corner produced obliquely downwards and backwards into a twisted plate of the end is hardly acute; lacinia projecting a moderate distance beyond the squama, narrowing to apex and then expanded inwards into a small tooth, lacinia almost bare, no dense bristles on volsellar area.

Illustrations. Sting—Richards, 1927 : fig. 48; Hazeltine & Chandler, 1964 : pl. 5. Gastral sternites 7 and 8—Radoszkowski, 1884 : figs. 18c, 19c, 27c; Pittioni, 1939a : pl. 1, fig. 3. Genitalia—Radoszkowski, 1884 : figs. 17a, b, 18a, b, 19a, b, 27a, b; Krüger, 1920 : pl. 5, fig. b; Richards, 1927 : fig. 26; Pittioni, 1939a : pl. 1, fig. 3.

EUROPE to IRAN and CENTRAL ASIA but not beyond the HIMALAYAS or in CHINA.

### 35. *FERVIDOBOMBUS* Skorikov, 1922

This is a large and varied subgenus with a considerable range of structure amongst the species; moreover several of them are not available in England.

♀. Ocelli separated by three diameters from eyes, lying just in front of postocular line. Frons swollen in front and coarsely punctured (closeness varying with the species), very closely and finely punctured behind, unpunctured areas rather large and ill-defined, a rather wide band of fine punctures along inner margin of eye. Dorsal furrow of gena absent. Antennal segments 3 : 4 : 5 = *c.* 9 : 4 : 6, segment 3 two to two and a half times as long as broad. Clypeus elongate, swollen, rather strongly and closely punctured, especially at sides, disk below rather widely unpunctured or with fine punctures, a line of several rows of fine punctures on mid line of dorsal third, apical impressions rather distinct with a few but large close punctures. Labrum with tubercles little raised, flattened and rounded, furrow rather narrow, not as wide as length of antennal segment 3, lamella wide, shining, thickened, edge nearly straight. Mandibles with no incisura, sulcus obliquus strong. Malar space quadrate to elongate, (13–18), from about as long as antennal segment 3 to rather longer than 2 + 3, usually with some fine punctures. Mid basitarsus with apical dorsal angle not or very feebly spinose produced into a relatively wide angular process. Hind tibia corbicular surface bare, feebly reticulate, with posterior ventral part convex, sometimes subangular in proximal part, inner dorsal apical angle not or little produced. Hind basitarsus not very acutely produced, bristles short. Gastral tergite 6 shining, feebly granulate. Sting variable, outer thickenings of sheath usually much wider above than below, inner thickenings strongly widened below then narrowing from about the midpoint where there is a large blackened area, membrane above thrown into a convex central fold. Wings usually strongly darkened.

♂. Size moderate. Eyes normal, ocelli separated by three diameters from eyes, lying just in front of postocular line. Antennae long, segments 3 : 4 : 5 : 8 = *c.* 7 : 4½ : 8 : 8½, penultimate segments a little curved. Mandibles with broad ventral and small dorsal tooth, beard long, dense and brown. Malar space quadrate to rather elongate (= 11–14), usually a little longer than antennal segments 3 + 4, with scattered fine punctures. Mid basitarsus rather long and parallel-sided (44 × 9) dorsal apical angle rounded right-angle, fringes short. Hind tibia not very long, convex, hairy all over, coarsely cross-striate and obliquely punctured, fringes short. Hind basitarsus parallel-sided and rather broad (48 × 16), apical dorsal angle a right angle, fringes short. Gaster with hairs rather short and even. Gastral sternite 6

with end rounded and a little thickened. Gastral sternite 7 very broadly crescentic posteriorly rounded, with two distinct discal patches of short bristles, no lines or fenestrae. Gastral sternite 8 with central quarter produced into a wide, almost parallel-sided tongue-shaped process, apex slightly emarginate, with a large area of dense short bristles, a central line which forks a little before the bristle patch. Genitalia of moderate size; stipes with a moderately well-defined impression of half its width; sagitta seen from above narrow, not bent down until just before apex where bent outwards into a hook-like structure of which the outer margin is straight-serrate, in side view sagitta considerably broader on basal half up to the mid-ventral tooth, then relatively narrow; spatha narrow, sides not convergent, at centre about twice as wide as sagitta; squama transverse, outer and posterior edges forming a continuous curve to a blunt exterior point on outer edge of stipes, inner margin produced into a vertical, plate-like anterior lamella and a more dorsal wider rounded process; lacinia produced a very little way beyond squama, strongly widened at apex, angularly produced at outer end and into a small curved hook at inner end, volsellar region with dense bristles.

Illustrations. Sting—Moure & Sakagami, 1962: fig. 3; Hazeltine & Chandler, 1964: pl. 3. Gastral sternites 7 and 8—Radoszkowski, 1884: fig. 28c; Franklin, 1913: figs. 32, 101, 126, 132, 148, 174; Moure & Sakagami, 1962: fig. 4. Genitalia—Radoszkowski, 1884: figs. 28a, b; Franklin, 1913: figs. 66, 70, 78, 102, 156, 159-164, 166-168, 170-171, 179, 182-183, 193, 196; Moure & Sakagami, 1962: figs. 5, 6.

#### NORTH and SOUTH AMERICA.

#### KEYS TO THE SUBGENERA OF *BOMBUS* LATREILLE

It is very difficult to make practical keys to the subgenera of *Bombus*, especially in the female sex. Apart from the intrinsic difficulties, few authors have seen more than a fraction of the species. There are of course also many nomenclatorial problems and points of doubt at the specific and subspecific level, though these do not affect a subgeneric key in principle. The keys which I have constructed are tentative and I would not claim that an inexperienced entomologist would find them very useful; even the expert will find that some species are troublesome and they may also detect errors. Nevertheless, no really comparable attempt has been made before and I hope that it may constitute a foundation for more successful efforts in the future. It is impossible at the moment to make useful keys to the worker caste, which is far too variable and often lacks the diagnostic characters of the female. In any district, when a study of the males and females has shown which species are present, it is usually possible to identify most of the workers.

#### MALES

♂ of *B. adventor* (Skorikov) and *B. exil* (Skorikov) were not available.

- 1 Mandibles distally ending in one large ventral and two small dorsal teeth. Antennal segment 4 0.73-0.74, segment 5 0.93 as long as segment 3. Mid and hind basitarsi with long fringes, hind tibia with a bare disk and very long dorsal and ventral fringes. Ocelli separated by three diameters from eyes. Genitalia with spatha very wide but strongly narrowed posteriorly; squama transverse or quadrate, inner side proximally with a small process separated by a moderate emargination from the posterior lobe; sagittae hooked inwards, tip blunt, outer side of hook with a considerable flange . . . . .

- Mandibles distally ending in one large ventral and one small dorsal tooth (absent in some *Mendacibombus*) . . . . . 3
- 2 Malar space a little shorter than antennal segment 3. Squama rounded-quadrate or with a long, pointed inner process . . . . . **ALPIGENOBOMBUS** (p. 221)
- Malar space half as long as antennal segment 3. Squama very transverse . . . . . **NOBILIBOMBUS** (p. 222)
- 3 Sagittae narrow and pointed. Antennae very long, antennal segment 4 1.1-1.4, segment 5 1.5-1.7 times as long as segment 3. Malar space nearly twice as long as antennal segment 3. Mid and hind basitarsi with short fringes, hind tibia bare on disk. Ocelli separated by three to three and a half diameters from eye. (Pakistan to W. China) . . . . . **ORIENTALIBOMBUS** (p. 224)
- If the sagittae are of this type, the ocelli are much closer to the eyes or the hind tibia is hairy, or if there is a small bare disk, the fourth antennal segment is about half as long as the third . . . . . 4
- 4 Sagittae curved outwards in a rounded hook. Antennal segments 4 and 5 1.2 and 1.5 times as long as segment 3. Ocelli separated by three diameters from eyes. Mid and hind basitarsus without long fringes, hind tibia with a bare disk and long fringes. Gastral sternite 7 strongly produced, sternite 8 with a narrow, parallel-sided, tongue-shaped projection. Stipes with the inner impression very feeble; squama twice as long as broad. (Europe) . . . . . **KALLOBOMBUS** (p. 225)
- Sagitta not curved outwards into a recurved hook. Antennal segments 4 and 5 relatively shorter (4 shorter than 3) except in a few species with short basitarsal fringes . . . . . 5
- 5 Antennal segments 4 and 5 0.36-0.56 and 0.48-0.78 times as long as segment 3. Eyes swollen, ocelli separated from them by one diameter or less. Mandibular beard usually not very well developed. Sagittae narrow and pointed, or finger-shaped, only in one group curved inwards with a flange outside the curve (Section **BOOPOBOMBUS**) . . . . . 6
- Antennal segments 4 and 5 relatively longer and sagittae usually of a different shape, particularly if the antennae are at all similar. Ocelli usually less close to the eyes . . . . . 9
- 6 Sagittae curved inwards with a small flange on the outside of the curve. Squama rather elongate, inner edge emarginate. Spatha narrow. Gastral sternite 7 long trapeziform, apex deeply emarginate. Gastral sternite 8 strongly produced, production tongue-shaped. Mid and hind basitarsi and hind tibia with short fringes. (S.W. America) . . . . . **FRATERNOBOMBUS** (p. 227)
- Sagittae pointed or finger-shaped. Hind basitarsus with a long dorsal fringe . . . . . 7
- 7 Squama in section V-shaped, formed of two plates set at an angle and joining at their outer edge. Genitalia small, pyriform. Spatha very wide, narrowing distally. Gastral sternite 7 crescentic but with rounded-triangular production. Gastral sternite 8 crescentic, little produced, subtruncate. Mid basitarsus with a fringe as long as its width, fringe of hind tibia long . . . . . **CONFUSIBOMBUS** (p. 228)
- Squama subquadrate, all angles rounded, not V-shaped in section . . . . . 8
- 8 Mid basitarsus with fringe mostly short, hind tibia with long fringes. Antennal segment 3 unusually long. Gastral sternite 7 crescentic, sternite 8 produced, sides a little rounded, apex distinctly emarginate. Spatha about twice as wide as sagitta. (Mountains of Eurasia) . . . . . **MENDACIBOMBUS** (p. 229)
- Mid basitarsus with a long fringe, hind tibia with very short ones. Gastral sternite 7 broadly triangular, apex feebly emarginate, sternite 8 broadly triangular with apex deeply emarginate. Spatha very wide, 5 times as wide as sagitta. (N. America) . . . . . **BOMBIAS** (p. 230)
- 9 Sagittae in the form of wide sinuate vertical plates. Lacinia projecting very little beyond squama which on inner side has a deep anterior emargination of which the proximal bounding lobe is linear. Spatha very wide. Mid and hind basitarsi

- with short fringes, hind tibiae with a bare disk and both fringes long. Ocelli separated by three diameters from eyes. Antennal segments 4 and 5 0.7 and 0.9 times as long as segment 3. (Eurasia and N. America) . **BOMBUS** s.s. (p. 226)
- Sagittae of a quite different form . . . . . 10
- 10 Sagitta ending in a strong, inwardly directed, recurved hook. Mid basitarsus with short fringes. Antennal segment 5 longer or (in *Separatobombus*) just shorter than 3 . . . . . 11
- Sagitta rarely ending in a strong, inwardly directed, recurved hook and if so the mid basitarsus with a long fringe . . . . . 16
- 11 Ocelli separated by less than one diameter from eyes. Malar space shorter than antennal segment 4. Hind basitarsus with a long fringe. Sides of spatha strongly convergent posteriorly. Squama a small or rather small rounded triangle, lacinia hardly projecting beyond it. (America) . . . . . 12
- Ocelli separated by more than one diameter from eyes. Malar space as long or longer than antennal segment 3. Sides of spatha subparallel, little convergent posteriorly. Sagitta ending in a more or less rounded, blunt-ended hook . . . . . 13
- 12 Sagitta ending in a rounded hook, tip not acute. Impression of stipes wide but ill-defined. Antennal segment 5 shorter than 3. Gastral sternite 7 trapeziform, apex feebly emarginate, sternite 8 subtriangular . . . **SEPARATOBOMBUS** (p. 231)
- Sagitta with a somewhat smaller hook, tip acute. Impression of stipes wide and well-defined. Antennal segment 5 longer than 3. Gastral sternite 7 subrescentic, sternite 8 with a parallel-sided, tongue-like projection . . . . . **CROTCHIIBOMBUS** (p. 231)
- 13 Squama considerably longer than broad, inner side emarginate, lacinia also elongate and projecting well beyond it. Impression of stipes strong, sharp-edged. Antennal segment 5 clearly shorter than 3. Hind basitarsus with a long fringe. Ocelli separated by one to two and a half diameters from eyes. Gastral sternite 7 rounded triangular, widely truncate, sternite 8 rounded triangular but slightly truncate or if produced, sides of production strongly divergent. (Eurasia). . . . . **SIBIRICOBOMBUS** (p. 232)
- Squama not clearly longer than broad, inner side not emarginate. Impression of stipes feebly defined. Antennal segment 5 longer than 3. Gastral sternite 7 trapeziform or crescentic.
- 14 Lacinia scarcely projecting beyond the squama (more so in *B. atrocinctus* Smith) which is small and rounded triangular. Hind basitarsus with a short fringe. Ocelli separated by at least three diameters from eye. Gastral sternite 8 with a parallel-sided, tongue-like projection. (Eurasia, N. America) **PYROBOMBUS** (p. 234)
- Lacinia very long, projecting well beyond the squama. Ocelli separated by less than three diameters from eyes. Gastral sternite 8 widely subtriangular . . . . . 15
- 15 Squama just transverse with inner side emarginate. Hind basitarsus with a short or long fringe. Malar space not longer than antennal segment 3. Ocelli separated by one and three quarters to two and a quarter diameters from eyes. (Eurasia and N. America) . . . . . **CULLUMANOBOMBUS** (p. 233)
- Squama S-shaped, inner end pointed, almost the whole of it lying inside the inner margin of the stipes. Hind basitarsus with a short fringe. Malar space longer than antennal segment 3. Ocelli separated by two and a half diameters from eyes. (E. Asia) . . . . . **RUFIPEDIBOMBUS** (p. 238)
- 16 Mid and hind basitarsi with long fringes . . . . . 17
- Mid and hind basitarsi with short fringes. Ocelli separated by three diameters from eyes. Malar space more or less elongate (Section **ODONTOBOMBUS**) . . . . . 23
- 17 Sagitta at end not curved inwards or outwards but with two external teeth, one of which is sometimes small. Antennal segment 4 not much shorter than 3, 5 one and a quarter times longer than 3. Malar space in most species distinctly longer than antennal segment 3. Gastral sternite 7 crescentic, 8 subtriangular.

- Spatha wide, sides strongly converging ; stipes with no inner impression ; squama longer than broad ; lacinia very long, apex on inner side produced into a feeble, rounded, serrate lobe. (Arctic-Alpine in Eurasia & N. America but not in mountains of S.E. Asia) . . . . . **ALPINOBOMBUS** (p. 239)
- Sagitta sometimes curved inwards but never with more than one outer tooth. Antennal segment 4 not more than three quarters as long as segment 3, 5 not more than one tenth longer than segment 3. Malar space rarely longer than antennal segment 3. . . . . 18
- 18 Lacinia projecting far beyond squama. Malar space as long as antennal segment 3 or a little longer. Sagitta with a sharp projection on inner side of apex. Antennal segment 4 0·57, segment 5 about 0·80 as long as segment 3. (Eurasia) . . . . . 19
- Lacinia relatively short, projecting at most a moderate distance beyond the squama which has rounded angles and an inner emargination. Malar space usually shorter than antennal segment 3. Ocelli separated by two diameters or less from eyes. (S. America) . . . . . 20
- 19 Squama completely fused with the stipes, produced into a long acute process directed downwards and backwards. Sagitta at apex with a small pointed flange on inside and a large pointed one on outside. Gastral tergite 7 widely trapeziform, 8 with a parallel-sided projection. Stipes with a broad, sharp-edged impression. Lacinia twisted so that its plane is oblique distally, with dense short hairs at apex and on inner side. Ocelli separated by three diameters from eyes. (Himalayas) . . . . . **PRESSIBOMBUS** (p. 237)
- Squama separate from stipes, rounded-transverse with a small, proximal inner process. Sagitta with an acute apex and an acute inner flange (half arrowhead). Gastral tergite 7 crescentic, 8 broadly triangular. Stipes narrow without an inner impression. Lacinia not twisted, with few hairs. Ocelli variable, separated by 1–3 diameters from eyes. (Eurasia). . . . . **MELANOBOMBUS** (p. 236)
- 20 Antennal segment 5 a little longer than 3. Impression of stipes wide and deep. Spatha relatively narrow, about one and a half times as wide as sagitta, sides not very convergent posteriorly . . . . . 21
- Antennal segment 5 distinctly shorter than 3. Impression of stipes not more than half its width. Squama rounded transverse, inner side emarginate . . . . . 22
- 21 Sagitta curved inwards at apex with a serrate flange on the outside. Spatha narrow, sides subparallel. Squama very transverse, widening inwards, inner edge emarginate. Lacinia with a rounded-angular projection on the inner edge, inner corner of apex with a long curved hook. Gastral sternite 7 crescentic, 8 with a tongue-like projection whose sides converge. Malar space hardly more than half as long as antennal segment 3. Ocelli separated by less than one diameter from eyes . . . . . **ROBUSTOBOMBUS** (p. 240)
- Sagitta slightly curved inwards at apex and with a small inner tooth. Squama rounded quadrangular with a large subcircular inner emargination. Lacinia wide, posterior end with a short hook, end with a dense tuft of relatively long bristles. Gastral sternite 7 transverse with central quarter produced, 8 subtriangular. Malar space a little shorter than antennal segment 3. Ocelli separated by one and a half diameters from eyes . . . . . **RUBICUNDOBOMBUS** (p. 241)
- 22 Stipes with strong impressions. Sagitta with a somewhat inward-curving pointed hook on inside and a narrow serrate flange outside. Lacinia short, apex with a small posteriorly directed hook, outer and ventral side with dense short hairs. Gastral sternite 7 transverse, apex biemarginate, 8 with a long, parallel-sided process. Malar space slightly longer than antennal segment 3. Ocelli separated by two diameters from eyes . . . . . **COCCINEOBOMBUS** (p. 243)
- Stipes with small ill-defined depressions. Spatha wide with strongly convergent sides. Sagitta with apex hooked inwards, externally with a serrate flange. Lacinia moderately long, apex with small hook-like projection at inner end.

- Gastral sternite 7 crescentic, weakly emarginate, 8 subtriangular. Malar space three quarters as long as antennal segment 3. Ocelli separated by less than two diameters from eyes . . . . . **FUNEBRIBOMBUS** (p. 244)
- 23 Lacinia long and narrow, produced inwards at apex into a process like a toe and heel. Sagitta narrow, outer side distally strongly serrate (character otherwise seen only in *B. pascuorum* (Scopoli)—*Thoracobombus*), no tooth beneath. Squama forming a large elongate, vertical, curved plate on inner side two thirds enclosing an oval space, anterior lower corner produced upwards into a sharp spike. Malar space as long as antennal segments 2 + 3 + 4. (Eurasia) **MEGABOMBUS** (p. 246)
- Lacinia long and narrow, produced inwards at apex into a spur-like process with several points. Sagitta narrow, sinuate, with an apical outer flange forming a small tooth at its proximal end, emarginate beneath but not forming a real tooth. Squama narrow and transverse, posterior inner corner produced into a thumb-shaped process, anterior inner corner with a long curved hook, extending as far back as posterior margin. Malar space as long as antennal segments 2 + 3. (E. Asia) . . . . . **DIVERSOBOMBUS** (p. 247)
- Lacinia at apex produced at most into a small hook or serrate, rounded lobe. In *Senexibombus*, somewhat similar to *Megabombus*, but the sagitta is serrate only at the recurved distal quarter . . . . . 24
- 24 Antennal segment 5 much ( $\times 1.5-1.9$ ) longer than segment 3 . . . . . 25
- Antennal segment 5 little ( $\times 1.0-1.3$ ) longer than segment 3 . . . . . 27
- 25 Antennal segment 4 less than 0.7 times as long as 3. Spatha very narrow. Squama very large, transversely oblique, proximal inner end produced into a large hook, beneath this hook can be seen a downwardly directed bifid process, the outer division longer and more acute than the inner one. Sagitta narrow, outer side serrate on distal quarter, first tooth of serrations large, beneath with a strong angle rather than a tooth. Malar space nearly as long as antennal segments 3 + 4. (E. Asia) . . . . . **SENEXIBOMBUS** (p. 248)
- Antennal segment 4 as long as or longer than segment 3. Spatha very broad with convergent sides . . . . . 26
- 26 Lacinia very wide, not extending far beyond outer part of squama, on inner side proximally with a very long acute hook, inner edge behind the hook straight truncate, somewhat serrate, with long bristles. Squama with elongate outer lobe set in an oblique plane, on inner side at a lower level produced into two very long acute processes, directed obliquely forwards and backwards respectively. Sagitta apically with an outer feebly serrate flange, beneath with a tooth. Malar space about as long as antennal segments 3 + 4. Gaster very closely punctured. (E. Asia) . . . . . **TRICORNIBOMBUS** (p. 249)
- Lacinia very long, broadly digitiform, near centre on inner side produced into a strong, parallel-sided process with an expanded end with sharp angles. Squama with large, outer part pale and submembranous, generally transverse but posteriorly produced on inside into a rounded lobe, before this deeply emarginate and then produced into a large subcircular lobe (mainly in a vertical plane) with its dorsal edge serrate and the whole attached to the squama by a narrow stalk. Sagitta narrow, simply pointed at apex, not toothed beneath. Malar space as long as antennal segment 4. (Eurasia) . . . . . **LAESOBOMBUS** (p. 251)
- 27 Sagitta at end somewhat hooked inwards and on outer side with two large teeth, mid-point beneath with bifid or trifold tooth. Stipes with wide, sharp-edged impressions. Inner edge of squama not emarginate, anterior inner corner sometimes produced into a vertical lamella. Hind tibial fringe long or short (Holarctic) . . . . . **SUBTERRANEOBOMBUS** (p. 257)
- Sagitta curved or hooked outwards, or pointed, or in one species serrate . . . . . 28
- 28 Malar space normally a little longer than antennal segments 3 + 4. Sagitta at end curved outwards (except *B. brevivillus* Franklin, *Fervidobombus*), this end-

- piece serrate or truncate, beneath with a central tooth. Stipes with rather well-defined inner impressions. Fringe of hind tibia short. . . . . 29
- Malar space a little shorter than antennal segments 3 + 4. Sagitta with a small pointed external lobe, or pointed, or serrate. Stipes without any distinct inner impressions. Squama produced inside into an obliquely downwardly directed, acute plate or spike. (Eurasia) . . . . . 30
- 29 Mandibles without a beard. Squama anteriorly on inside produced obliquely downwards and backwards into a twisted plate of which the end is hardly acute. Lacinia with apex on inside produced into a small lobe with a small tooth. Truncate end of sagitta not serrate. Volsellar region with no very conspicuous bristles. (Eurasia) . . . . . **RHODOBOMBUS** (p. 258)
- Mandibles with a beard. Squama on inside usually produced into a vertical plate-like anterior lamella and a more dorsal wider rounded process (details vary considerably in different species). Truncate end of sagitta sometimes serrate (in *B. brevivillus* Franklin the sagitta is simply pointed). Lacinia with apex on inside produced into a small hook or angular process. Volsellar region with dense bristles. (N. and S. America) . . . . . **FERVIDOBOMBUS** (p. 259)
- 30 Lacinia long and broad, finger-shaped, centre of inner edge produced into a wide lobe defined at each end by a small tooth or else simple, inner and often ventral surface with dense, quite long pubescence. Sagitta beneath simple or emarginate but with no distinct tooth . . . . . 31
- Lacinia wide but not very long, apex more pointed, pubescence less dense and wide-spread, centre of inner edge produced into a spike or at least a narrow, truncate process. Sagitta variable but with a central tooth beneath. Fringe of hind tibia long . . . . . **THORACOBOMBUS** (p. 255)
- 31 Lacinia with centre of inner edge produced into a wide lobe defined at each end by a small tooth. Sagitta simply pointed, with no tooth or emargination beneath. Hind tibia with a long fringe . . . . . **MUCIDOBOMBUS** (p. 256)
- Lacinia with inner edge straight or feebly concave, with no lobe or process. Sagitta at end hardly acute, with a slight outer, feebly serrate, flange, ventrally bi-emarginate but without a tooth. Fringe of hind tibia short . . . . . **EVERSMANNIBOMBUS** (p. 252)

## FEMALES

- 1 Apex of mandibles with six teeth. Mid basitarsus with posterior apical angle more or less clearly acute. Hind basitarsus proximally near ventral margin often with a number of bristles almost as long as the corbicular bristles. Sting-sheath with the outer thickenings rather narrow, of even width; inner thickenings moderately widened below and gradually narrowed upwards, centre of wide part blackened, membrane between blackened on a lateral lobe projecting down to mid-point . . . . . 2
- Apex of mandibles with one small dorsal tooth and, when an incisura is developed, the ventral corner may also project to some extent. Hind basitarsus normally with no bristles as long as the corbicular bristles [except in *Mendacibombus* and *Pressibombus*] . . . . . 3
- 2 Malar space strongly transverse, shorter than antennal segment 3. Ventral mandibular tooth directed inwards. (Pyrenees and Norway to Himalayas and China) . . . . . **ALPIGENOBOMBUS** (p. 221)
- Malar space about quadrate, longer than antennal segment 3. Ventral mandibular tooth directed downwards. (Himalayas s.l.) . . . . . **NOBILIBOMBUS** (p. 222)
- 3 Mid basitarsus with posterior apical angle obtuse, more or less rounded. [Except for some *Sibiricobombus*, most of which have the ocelli separated by about two

- diameters from eyes ; they also differ from the species of *Subterraneobombus* which they often most resemble in having the whole surface of the auricle of the hind basitarsus densely hairy (Text-fig. 38). *Bombus languticus* Morawitz (*Melanobombus*) has the basitarsus produced but has a strong, bare subcircular boss on gastral tergite 6 such is not found in *Odontobombus*] . . . . . 4
- Mid basitarsus with posterior apical angle usually spinose, at least very distinctly acute. Malar space usually at least longer than broad, often distinctly elongate. Ocelli separated by three diameters from eyes. (Section *Odontobombus*) . . . . . 22
- 4 Outer surface of hind tibia densely reticulate, dull, some long bristles arising from disk down to near its mid-point. Malar space very elongate. Antennal segment 3 fully three times as long as wide in centre. Outer thickenings of sting-sheath very narrow, inner ones very narrow, of even width, no blackened areas. (Pyrenees to Himalayas and other asiatic mountains) . . . . . **MENDACIBOMBUS** (p. 229)
- Outer surface of hind tibia less coarsely reticulate, rarely if ever so dull, long bristles confined to margins except very near the base or else the malar space is transverse. Antennal segment 3 nearly always shorter . . . . . 5
- 5 Malar space very long, longer than antennal segments 2 + 3. Antennal segment 3 about four times as long as broad. Lateral ocelli usually separated by not much more than two diameters from eyes. Clypeus usually with rather numerous, scattered, rather fine punctures, apical impressions with dense fine punctures. Mid basitarsus with posterior apical angle somewhat produced. (Some species, see couplet 3, are difficult to separate from some of *Subterraneobombus*, cf. couplet 29.) Outer thickenings of sting-sheath rather narrow, sometimes a little widened above, inner thickenings narrow very little widened below ; membrane brown and convex in a small dorsal region and with a somewhat blackened lobe laterally near centre. (E. Europe to Asia, where mainly in mountains)
- SIBIRICOBOMBUS** (p. 232)
- Malar space clearly shorter or, if not, antennal segment 3 not so long (about two and a half times as long as broad). Mid basitarsus with posterior angle quite obtuse . . . . . 6
- 6 Corbicular hairs unusually dense, tibial surface between them covered throughout with rather sparse but quite distinct, very short feathered hairs. Very large species ; wings usually coloured, dark or yellow brown. Malar space about quadrate. Mandibles with weak or no incisura, no sulcus obliquus. Clypeus generally little punctured, mid line dorsally with many, usually fine, punctures, apical depressions with coarse punctures and sometimes fine ones as well. Punctures of frons all relatively fine, unpunctured areas large. Outer thickenings of sting-sheath narrow but considerably widened above, inner thickenings widened from below to just above middle then narrowed again, edge considerably blackened, adjacent to this on each side a strong, shining, convex fold of membrane. (Himalayas to Formosa and Sumatra) . . . . . **RUFIPEDIBOMBUS** (p. 238)
- Corbicular hairs less dense, tibial surface between them without these short feathered hairs except in a few *Melanobombus* (couplet 8). (*B. coccineus* Friese has short, non-feathered hairs, but gastral tergite 6 has a deep furrow and the unpunctured area of the frons has a band of microscopic punctures.) . . . . . 7
- 7 Frons with unpunctured areas very large ; most of the area for some distance in front of the ocelli unpunctured and a narrow band of punctures between the ocelli and eyes ; area immediately behind the ocelli also unpunctured. Large species with dark wings. Ocelli separated by three diameters from eyes. Malar space considerably longer than broad, clearly longer than antennal segments 2 + 3, antennal segment 3 two and a half times as long as wide at apex. Mandibles with no incisura. Clypeus with few punctures and these nearly all fine, apical impressions sparsely punctured. Labral lamella straight, wide, but not very clearly defined. Outer thickenings of sting-sheath of moderate, even width ;



- inner thickenings moderately wide and gradually narrowing upwards, inner margin blackened for a considerable distance and adjacent membrane also blackened. (Kashmir to S. China) . . . . . **ORIENTALIBOMBUS** (p. 224)
- Frons without this large unpunctured area, especially in front of the ocelli ; or else densely punctured right up to them posteriorly and ocelli closer to eyes . . . . . 8
- 8 Sixth gastral tergite with a bare, convex, more or less rounded boss. Hind tibia with dorsal inner corner not or rarely somewhat produced. Hind basitarsus as a rule with unusually dense, short, feathery hairs. Wings rarely dark, tip not particularly darkened. Malar space about quadrate or, if distinctly longer, the ocelli are separated by two to two and a half diameters from eyes, or the species is very large and dark winged. Antennal segments  $3 : 4 : 5 = 8 : 5\frac{1}{2} : 6$ . Frons with quite numerous fine punctures along inner margin of eyes. Outer thickenings of sting-sheath generally narrow but much widened for a short distance dorsally, inner thickenings widened for a considerable distance then narrowed again dorsally, edge sometimes blackened and intervening membranous folds sometimes also blackened. (Europe to India, China and Formosa)
- . . . . . **MELANOBOMBUS** (p. 236)
- Sixth gastral tergite without a convex rounded boss. Hind tibia with dorsal distal inner corner more or less strongly angularly produced (except in *Kallobombus* and a few *Pyrobombus*—*B. pratorum* (Linnaeus), *B. atrocinctus* Smith). Hind basitarsus rarely so densely haired . . . . . 9
- 9 Whole discal surface of hind tibia with scattered but quite numerous short unbranched hairs. Ocelli separated by two and a half diameters from eyes. Frons with unpunctured area moderately large crossed by a wide transverse band of microscopic punctures, inner margin by eye with numerous very microscopic punctures and a few rather large ones. Malar space just transverse. Gastral tergite 6 with a raised boss (almost as in *Melanobombus*) but divided by a deep, well-defined furrow. Outer thickenings of sting-sheath narrow but considerably widened dorsally, inner thickenings narrow but moderately widened, on ventral quarter, not darkened ; membrane dark and rather convex dorsally. (Peru)
- . . . . . **COCCINEOBOMBUS** (p. 243)
- Hind tibia at least with a considerable distal discal area bare. Frons without a band of microscopic punctures across the unpunctured area. Gastral tergite 6 never with such a deep, well-defined furrow . . . . . 10
- 10 Malar space distinctly transverse. Either a definite band of close punctures along inner margin of eyes or ocelli separated by about two diameters from eyes, or both . . . . . 11
- Malar space elongate, quadrate or just transverse. In the members of *Pyrobombus* with a distinctly transverse malar space, there are no fine punctures along the inner eye-margin and the ocelli are separated by three diameters from eye ; antennal segment 3 clearly shorter than  $4 + 5$ . . . . . 16
- 11 Ocelli lying just in front of postocular line, separated by three diameters from eyes and corbicular surface of hind tibia entirely bare and shining. Mandibles with a strong incisura, sulcus obliquus moderately distinct. Clypeus strongly punctured on almost its whole surface. Outer thickenings of sting-sheath narrow, widened dorsally for a short distance only ; inner thickenings relatively wide, twice emarginate, the processes so formed more or less bent inwards, membrane undifferentiated. (Eurasia and N. America to Mexico) . . . . . **BOMBUS** s.s. (p. 226)
- *Either* ocelli not separated by more than two diameters from eyes *or* the proximal half or third of corbicular surface bristly and the whole surface more or less strongly reticulate ; or both these characters present. Mandibles with no or with a weak incisura, sulcus obliquus strong (except in *Crotchiibombus* Franklin). Clypeus sometimes with some sparse large punctures but if punctures are close they are small. . . . . 12

- 12 Hind tibia with its corbicular surface bare. Clypeus swollen with fine and rather close punctures. Ocelli separated by two diameters or less from eyes, well in front of postocular line. (U.S.A. and C. America) . . . . . 13
- Hind tibia with proximal half or third of its corbicular surface bristly. (C. and S. America) . . . . . 15
- 13 Frons with rather strong, close, punctures along inner margin of eyes. Clypeus elongate, impressions feeble, finely and closely punctured. Labral furrow wide and deep, nearly as wide as length of antennal segment 3. Mandibles with a strong sulcus obliquus. Outer thickenings of sting-sheath moderately wide both above and below, inner thickenings rather strongly widened on lower third and evenly narrowing and running to top at a constant width ; a little darkened where it narrows. Membrane dorsally projecting and produced down each side into an elongate-ovate, blackened lobe. (N. America) **SEPARATOBOMBUS** (p. 231)
- Frons rather sparsely punctured all round the ocelli except for a densely punctured area immediately behind them ; unpunctured areas large and ill-defined, without a band of fine punctures near the eye though in *Crotchiibombus* a band of very fine punctures may be seen set rather more discally. Clypeus short, impressions with coarse punctures. Labral furrow deep and narrower. (Mandibles with a weaker sulcus obliquus in *Crotchiibombus*.) . . . . . 14
- 14 Malar space clearly shorter than antennal segment 3 which is shorter than twice the length of 4. Clypeus more coarsely though shallowly punctured, impressions weaker. Labral tubercles more convex but less angular, furrow deep, rather wider than length of antennal segment 3. Corbicular hairs shorter than half tibial width and dense. Outer thickenings of sting-sheath narrow and of about constant width, inner thickenings considerably widened and blackened on lower third, above this very narrow ; membrane undifferentiated. (N. America)
- FRATERNOBOMBUS** (p. 227)
- Malar space clearly longer than antennal segment 3 which is nearly as long as twice the length of 4. Clypeus more finely punctured, impressions stronger. Labral tubercles less raised but more angular at inner end, furrow deeper and much narrower than the length of antennal segment 3. Corbicular hairs mostly longer than half the tibial width and less dense. Outer thickenings of sting-sheath rather wide but narrowed in centre, inner thickenings widened for a short distance ventrally, then rather suddenly narrowed and of constant width to the top, considerably blackened on lower half ; membrane with a blackened convex area close to the narrowing of the inner thickenings. (N. and C. America)
- CROTCHIBOMBUS** (p. 231)
- 15 Frons rather closely punctured, with large but well-defined unpunctured areas and a band of fine punctures along inner margin of eyes. Ocelli separated by three diameters from eyes and lying a little in front of postocular line. Clypeus with numerous punctures, mostly rather large, swollen with ventral third flattened. Labral furrow narrow. Hind basitarsus not unusually bristly. Outer thickenings of sting-sheath very wide, inner thickenings gradually widening from below but soon ending in a right-angled truncation, above this widening again in a regular curve, inner margin somewhat blackened, membrane forming two somewhat pyriform, convex, deep brown lobes. (C. and western S. America)
- RUBICUNDOBOMBUS** (p. 241)
- Frons with large unpunctured or very sparsely punctured areas in front of and around the ocelli, no specially defined unpunctured areas, no band of punctures along inner margin of eyes. Ocelli separated by two diameters from eyes and lying well in front of postocular line. Clypeus strongly swollen, sometimes somewhat flattened ventrally, little or moderately punctured, apical impressions feeble. Labral furrow wide or very wide. Hind basitarsus with bristles on its outer surface longer and more numerous than usual. Outer thickenings of

sting-sheath of constant width, moderately broad, inner thickenings considerably widened below and ending in a finger-shaped blackened process, a somewhat similar process projects from above almost to meet it, margin of small area enclosed between these processes also sometimes blackened; intervening membrane sometimes raised into a horseshoe-shaped fold. (C. and S. America)

**ROBUSTOBOMBUS** (p. 240)

- 16 Malar space much or at least distinctly longer than broad, at least as long as antennal segments 2 + 3, often as long as 3 + 4. Clypeus moderately long and swollen, generally but not very coarsely punctured, apical impressions strong, strongly and more or less closely punctured. Antennal segments 3 : 4 : 5 = 9 : 6 : 7. Frons rather finely punctured, especially behind the level of the ocelli, unpunctured areas ill-defined, a rather broad band of fine sculpture along inner margin of eyes. Ocelli separated by three diameters from eyes, just in front of or almost on the postocular line. Inner thickenings of sting-sheath strongly widened below, two isolated blackened spots in the membrane between them. (Alps, N. Scandinavia, Arctic Eurasia, Arctic America, Rockies, Sierras, to Colorado and California) . . . . .

**ALPINOBOMBUS** (p. 239)

- Malar space transverse, quadrate or a little longer than broad, never more than a little longer than antennal segment 3. . . . .

17

- 17 Mandibles with no incisura but with ventral apical angle produced into a small process, sulcus obliquus rather strong. Ocelli separated by two and a half diameters from eyes, rather distinctly in front of postocular line. Labral tubercles convex, angled at inner end, furrow narrow, narrower than length of antennal segment 3. Frons quite closely punctured, unpunctured areas large but well-defined, a wide band of fine punctures along the eyes. Outer thickenings of sting-sheath moderately wide, inner thickenings gradually but not very strongly widened from below, ending in a rounded blackened knob, above this slightly widened again and sending down an ill-defined blackened process towards the knob; lower part and adjacent membrane somewhat blackened, membrane otherwise undifferentiated. (C. and S. America) . . . . .

**FUNEBRIBOMBUS** (p. 244)

- Mandibles sometimes with an incisura but not with the ventral apical angle produced into a short process . . . . .

18

- 18 Labral tubercles little raised and much rounded, furrow shallow and ill-defined. Ocelli separated by two and a half diameters or less from eyes, well in front of postocular line. Mandibles with no incisura and a weak sulcus obliquus. Antennal segment 3 as long as or hardly longer than 4 + 5 . . . . .

19

- Labral tubercles more or less raised and flattened, inner end more or less angled, furrow deeper and well-defined. Ocelli more widely separated from eyes (except some *Cullumanobombus*). Antennal segment 3 clearly shorter than 4 + 5. Malar space quadrate or more or less transverse. . . . .

20

- 19 Malar space a little longer than broad and a little longer than antennal segment 3. Clypeus with a wide flattened disk, closely and finely punctured, especially on lower third, impressions ill-defined but closely punctured. Frons mostly closely and rather finely punctured, unpunctured areas well-defined, a wide band of close fine punctures along inner margin of eyes. Outer thickenings of sting-sheath not broad but a little more so above than below, inner thickenings very narrow, membrane convex dorsally and sending down to centre two large blackened lobes on each side. (C. Europe) . . . . .

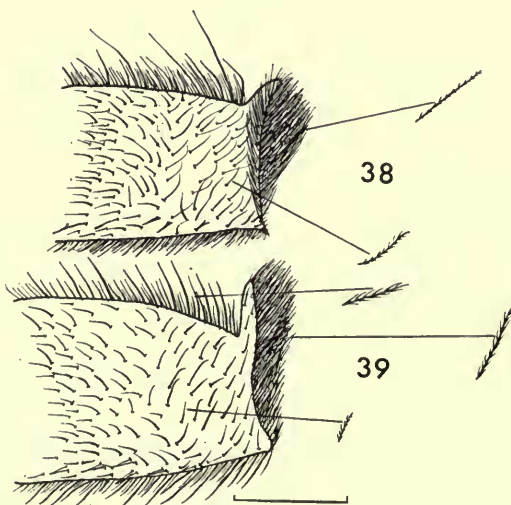
**CONFUSIBOMBUS** (p. 228)

- Malar space about quadrate, about as long as antennal segment 3. Clypeus long, strongly swollen, closely and finely punctured, impressions very weak and not more punctured. Frons moderately strongly and closely punctured, unpunctured areas large and ill-defined, a narrow band of rather fine sculpture along inner margin of eyes. Outer thickenings of sting-sheath a little wider above than below, inner thickenings rather narrow and of almost constant width, edge upturned, especially

- below, membrane undifferentiated except for some lateral blackening. (N. America) . . . . . **BOMBIAS** (p. 230)
- 20 Ocelli separated by somewhat or distinctly less than three diameters from eyes, well in front of postocular line. Hind basitarsus rather less pubescent than usual. Frons closely and rather finely punctured, unpunctured areas small and well-defined, a wide band of fine sculpture along inner margin of eyes. Mandibles with no incisura and a rather strong sulcus obliquus. Outer thickenings of sting-sheath considerably widened above, inner thickenings rather strongly widened and a little blackened below, two small blackened areas in membrane opposite centre of widened part. (Eurasia, N. and C. America)
- CULLUMANOBOMBUS** (p. 233)
- Ocelli separated by fully three diameters from eyes, hardly in front of postocular line . . . . . 21
- 21 Clypeus rather strongly and evenly punctured, impressions strong but not more closely punctured. Frons rather closely punctured, unpunctured areas small and well-defined, a wide band of fine sculpture along inner margin of eyes. Mandibles with no incisura or sulcus obliquus. Hind basitarsus with sparse pubescence and no long bristles. Outer thickenings of sting-sheath moderately wide, especially above, inner thickenings rather strongly widened upwards to above middle then suddenly narrowed, edge of wide part a little blackened, a slight dorsal fold but no black spots in the membrane. (Europe) **KALLOBOMBUS** (p. 225)
- Clypeus, except impressions, largely unpunctured (more strongly and closely in *B. lapponicus* (Fab.)). Frons mostly rather sparsely punctured, unpunctured areas ill-defined, no fine punctures along inner margin of eyes, the margin being largely shining. Mandibles with a well-marked incisura but no sulcus obliquus. No long bristles on hind basitarsus which is not usually very densely haired. Outer thickenings of sting-sheath narrow but considerably widened for a short distance dorsally, inner thickenings narrow and scarcely widened or blackened, two large blackened spots in membrane (at least of copulated ♀) (Europe, Asia, including Malayan Archipelago, N. and C. America) **PYROBOMBUS** (p. 234)
- Clypeus with fairly numerous scattered punctures, mostly small but some large. Frons not closely nor coarsely punctured, unpunctured areas not large, ill-defined, no fine punctures along inner margin of eyes, the margin being largely shining. Mandibles with feeble incisura and no sulcus obliquus. Hind basitarsus densely pubescent, lower edge for its whole length and disk in part with long bristles. Outer thickenings of sting-sheath not wide but wider above than below, inner thickenings very wide, widest just above middle and gradually narrowing above and below, considerably blackened, especially near middle; membrane little differentiated except for a darkened dorsal patch. (Himalayas)
- PRESSIBOMBUS** (Frison) (p. 237)
- 22 Malar space twice as long as antennal segment 3 . . . . . 23
- Malar space less than 1.30 times as long as antennal segment 3 . . . . . 25
- Malar space 1.40-1.80 times as long as antennal segment 3 . . . . . 27
- 23 Antennal segment 3 a little shorter than 4 + 5 (10½ : 11). Mid line of clypeus dorsally with a slight furrow or line of close punctures. Furrow between labral tubercles narrower. Mid basitarsus acutely spinosely produced. Outer thickenings of sting-sheath rather wide, of fairly constant width, inner thickenings considerably widened below to above the mid point, this part with a blackened edge and ending in a small blackened projection, above this emarginate and then with a rounded projecting lobe of which the base is blackened, membrane between thrown into two longitudinal folds. (Eurasia north and west of Himalayas)
- MEGABOMBUS** (p. 246)
- Antennal segment 3 clearly shorter than 4 + 5 (at most 11½ : 13). Furrow between labral tubercles wider. Mid basitarsus with the production wider, hardly spinose. 24

- 24 Inner dorsal angle of hind tibia not or hardly produced apically. Much of clypeus rather strongly and closely punctured, mid line on dorsal third with several rows of fine punctures (cf. couplet 36). A few species of *FERVIDOBOMBUS* (p. 259)
- Inner dorsal angle of hind tibia pointed apically though the point is short and broad. Clypeus finely or little punctured, no rows of punctures on mid line dorsally (cf. couplet 35). . . . . Some species of *SUBTERRANEOBOMBUS* (p. 257)
- 25 Frons with large unpunctured areas separated from eyes by a narrow band of close, fine punctures. Malar space unpunctured. Mid basitarsus spinosely produced. Outer thickenings of sting-sheath not wide, a little wider above, inner thickenings moderately widened over most of dorsal half, a little blackened, membrane not differentiated. (Eurasia, north and west of the Himalayas)
- LAESOBOMBUS* (p. 251)
- Frons with small unpunctured areas, separated from eyes by a wide band of fine punctures . . . . . 26
- 26 Mid basitarsus broadly produced. Band of fine punctures along inner edge of eye not spreading over the unpunctured area of frons. Labral lamella not prominent. Malar space with many fine punctures. Outer thickenings of sting-sheath rather narrow but somewhat wider dorsally, inner thickenings narrow but somewhat widened on central two thirds and the margin at the centre somewhat blackened, adjacent membrane also somewhat blackened but otherwise undifferentiated. (E. Europe and W. Asia but not in Himalayas)
- EVERSMANNIBOMBUS* (p. 252)
- Mid basitarsus spinosely produced. Band of fine punctures along inner edge of eye spreading halfway across unpunctured area of frons. Labral lamella considerably thickened. Malar space unpunctured. Outer thickenings of sting-sheath wide above, narrow below, inner thickenings moderately wide on lower half, gradually but much narrowed above, membrane with two indefinite dorsal lobes. (E. Mongolia and Ussuri distr.) . . . . . *EXILOBOMBUS* (p. 253)
- 27 Gastral tergites with very close coarse punctures except tergite 6 which has coarse granules. Mid basitarsus acutely spinosely produced. Hind tibia with corbicular surface strongly reticulate. Length malar space : antennal segment 3 = 1.60. Frons with rather small and well-defined unpunctured areas with a wide band of close fine punctures along inner margins of eyes. Outer thickenings of sting-sheath not wide except quite dorsally, inner thickenings very wide and bent inwards, ending rather suddenly dorsally and here somewhat blackened though generally pale brown ; membrane not generally differentiated but with a convex central fold at dorsal end. (Asia, especially north-eastern)
- TRICORNIBOMBUS* (p. 249)
- Gastral tergites without such close, coarse punctures . . . . . 28
- 28 Frons with no band of close fine punctures along the inner margin of eyes, unpunctured area large and ill-defined. Clypeus closely and coarsely punctured. Length malar space : antennal segment 3 = 1.50. Mid basitarsus acutely spinosely produced. Hind tibia with corbicular surface feebly reticulate. Outer thickenings of sting-sheath rather wide, even wider dorsally, inner thickenings rather narrow with a moderately wide section near centre, above this blackened and the black part with a small downward projection into the membrane from about the middle, intervening membrane thrown into two big folds. (Malaysia, Philippines, Indonesia) . . . . . *SENEXIBOMBUS* (p. 248)
- Frons with a band of close fine punctures along the inner margin of eyes. . . . . 29
- 29 Malar space very long and third antennal segment about four times as long as broad. Auricle of hind basitarsus with dense brown pile even on surface not apposed to hind tibia (Text-fig. 38. Inner thickenings of sting-sheath very little widened even below and membrane only with a narrow blackened lateral lobe.
- Some species of *SIBIRICOBOMBUS* (see couplet 5).

- Malar space and third antennal segment shorter. A few species of *Subterraneobombus* (couplet 34) are not very different but in them the auricle (fig. 39) has dense pile only on the surface apposed to the end of the hind tibia and the inner thickenings of the sting-sheath project strongly, are heavily sclerotized, and the intervening membrane has two very large lateral folds. . . . . 30
- 30 Mid basitarsus acutely spinosely produced . . . . . 31
- Mid basitarsus acute but not spinose . . . . . 35
- 31 Malar space longer, about as long as antennal segments 2 + 3 + 4. Labral furrow narrower and deeper. Inner dorsal angle at apex of hind tibia little produced . . . . . 32
- Malar space not longer than antennal segments 3 + 4; antennal segment 5 only a little longer than 4. Hind basitarsus quite strongly produced . . . . . 33
- 32 Antennal segment 5 clearly longer than 4 which is transverse rather than quadrate and shorter than in any other group of *Odontobombus*. Hind basitarsus little produced apically. Outer thickenings of sting-sheath moderately wide, especially above, inner thickenings strongly almost angularly widened, widest well below middle, not blackened; membrane hardened and darkened dorsally. (Asia)
- DIVERSOBOMBUS** (p. 247)
- Antennal segment 5 very little longer than 4 which is at least quadrate. Hind basitarsus distinctly produced apically. Outer thickenings of sting-sheath somewhat wider dorsally than ventrally, inner thickenings widening very gradually upwards, widest near the top then rather suddenly narrowing, a slight blackening of the edge near the centre; two small central folds at the top of the membrane. (I have not seen a male of this group and the genitalia do not seem to have been illustrated.) (Asia)
- ADVENTORIBOMBUS** (p. 254)
- 33 A large unpunctured area in front of median ocellus, lateral unpunctured areas large but well-defined, band of fine sculpture along inner margins of eye narrow. Antennal segment 3 just longer than 4 + 5. Apical impressions of clypeus small and narrow with close larger punctures, mostly in rows. Inner dorsal angle at apex of hind tibia not or hardly produced. Outer thickenings of sting-sheath rather narrow, only a little wider dorsally, inner thickenings moderately and



FIGS. 38-39. Auricle of right hind basitarsus of, 38, *Bombus miniatocaudatus* Vogt; 39, *B. fragrans* Pallas.

- evenly widened over most of their length, thickenings rather dark ; membrane thrown into two small dorsal brown folds. (Eurasia north and west of Himalayas). (cf. also couplet 37) . . . . . **RHODOBOMBUS** (p. 258)
- Area in front of median ocellus coarsely but not closely punctured, lateral unpunctured areas of moderate size, fairly well-defined, band of fine sculpture along inner margin of eyes wide or rather wide, antennal segment 3 shorter than or as long as 4 + 5. Inner dorsal apical angle of hind tibia more acutely produced. 34
- 34 Malar space as long as antennal segments 3 + 4. Apical impressions of clypeus rather strong with close, moderately coarse punctures. Labral tubercles flattened, furrow shallow. Outer thickenings of sting-sheath moderately wide, especially above, inner thickenings moderately or rather strongly broadened to the middle or rather higher, the top of the broad part projecting as a slight spur, margin below the broadest part a little blackened, membrane undifferentiated. (Eurasia, north and west of Himalayas) . . . . . **THORACOBOMBUS** (p. 255)
- Malar space not quite as long as antennal segments 2 + 3. Apical impressions of clypeus weak with a narrow deeper strip with close moderately coarse punctures. Labral tubercles somewhat raised and angular at the inner end, furrow moderately deep. Outer thickenings of sting-sheath rather narrow even dorsally, inner thickenings gradually widening upwards for almost whole length, widest just before the top and blackened for a short distance below this ; membrane undifferentiated. (Eurasia, west and north of Himalayas) **MUCIDOBOMBUS** (p. 256)
- 35 Species often large or very large, clypeus swollen with no furrow or lines of punctures on dorsal third of mid line, general surface often but not in all species considerably punctured. Malar space variable, ratio of its length to that of the third antennal segment from 1.43 (*B. fragrans* Pall.) to over 2.10 (*B. difficillimus* Skor.). Hind tibia with inner dorsal apical angle sharp though production rather wide. Outer thickenings of sting-sheath not very wide and of even width, inner thickenings rather strongly widened in a regular curve, widest at about the middle, a sharp black patch just above this ; membrane dorsally on each side thrown into a strong dark fold which touches the inner thickening, about meets its fellow and extends down to mid point. (See also couplet 24.) (Eurasia, N. America) **SUBTERRANEOBOMBUS** (p. 257)
- Clypeus with a slight furrow or distinct lines of punctures on mid line of dorsal third. Malar space of medium length or, rarely, rather long. Hind tibia with inner dorsal apical angle not or scarcely produced . . . . . 36
- 36 Clypeus with widespread but sparse fine punctures. Mid basitarsus more spinosely produced. Frons less punctured with a larger area in front of and at sides of ocelli unpunctured. (See couplet 32.) . . . . . **RHODOBOMBUS** (p. 258)
- Clypeus generally with closer and coarser punctures. Mid basitarsus often not very distinctly produced. Frons more punctured, with unpunctured areas smaller. Species often large or very large. Outer thickenings of sting-sheath much wider above than below, inner thickenings strongly widened below, then narrowing from about mid point where there is a large blackened area ; membrane dorsally thrown into a convex central fold. (N. and S. America) **FERVIDOBOMBUS** (p. 259)

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